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E6x Body Electronics

Model: E60, E61, E63 and E64

Production: All

OBJECTIVES

After completion of this module you will be able to:

- Identify and locate electrical components
- Explain the operation of body electrical systems
- Diagnose body electrical systems
- Perform various service related functions

General Vehicle Electrical Systems

This module contains information pertaining to various body electrical systems. The vehicles covered include the E60, E61, E63 and E64. The primary focus will be on the E60. Differences between the E60/E61 and the E63/E64 body electronics will be pointed out as necessary. Unless otherwise mentioned, the E63/E64 body electronics are identical to the E60.

E60



E61



E63



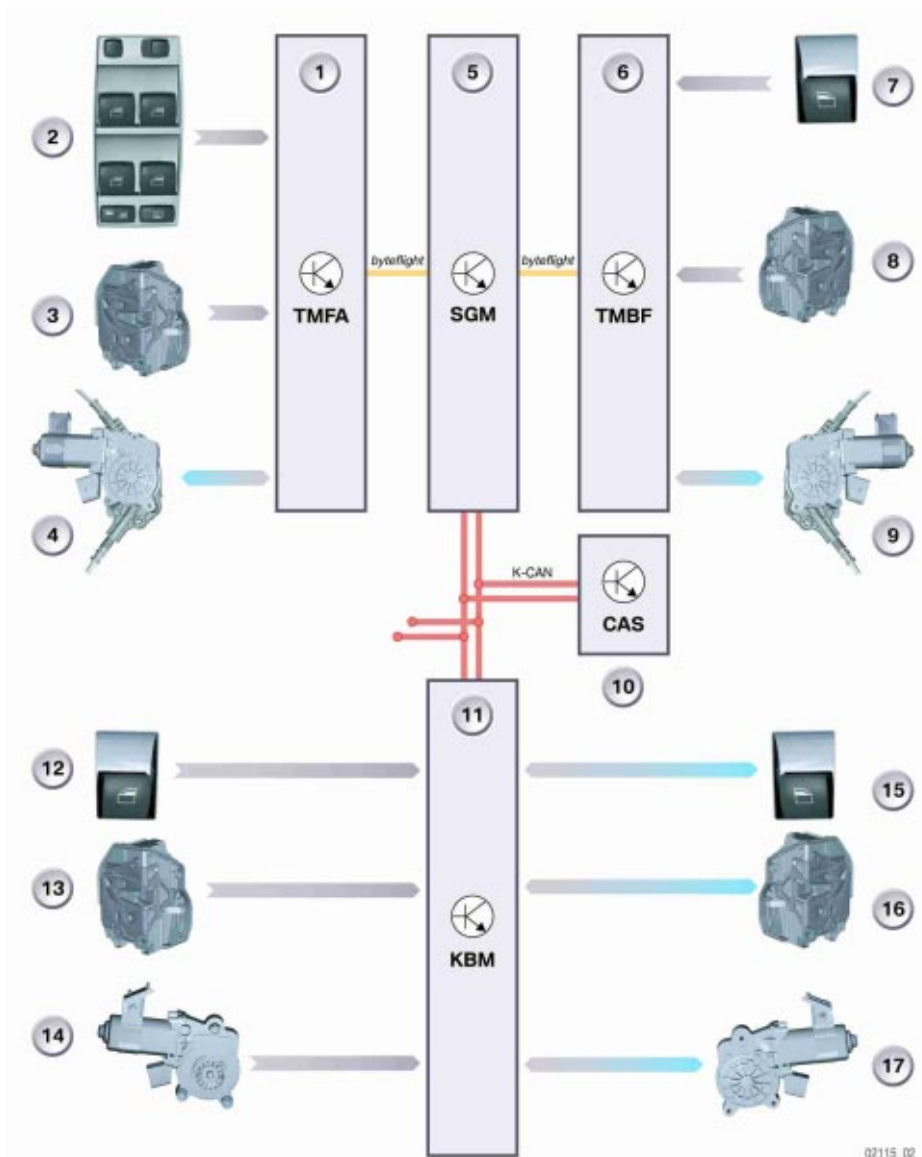
E64



The components and operation of the following electrical systems will be presented:

- KBM
- Anti-theft alarm system
- Interior lighting
- Windshield wiping and washing
- Exterior lighting
- Sliding/tilting sunroof
- Car Access System (CAS)
- E61 Multi Drive Sunroof (MDS)
- Central locking system
- Active cruise control
- Power windows
- Park Distance Control
- Roller sunblind
- E63 Multi Drive Sunroof (MDS)
- AHL

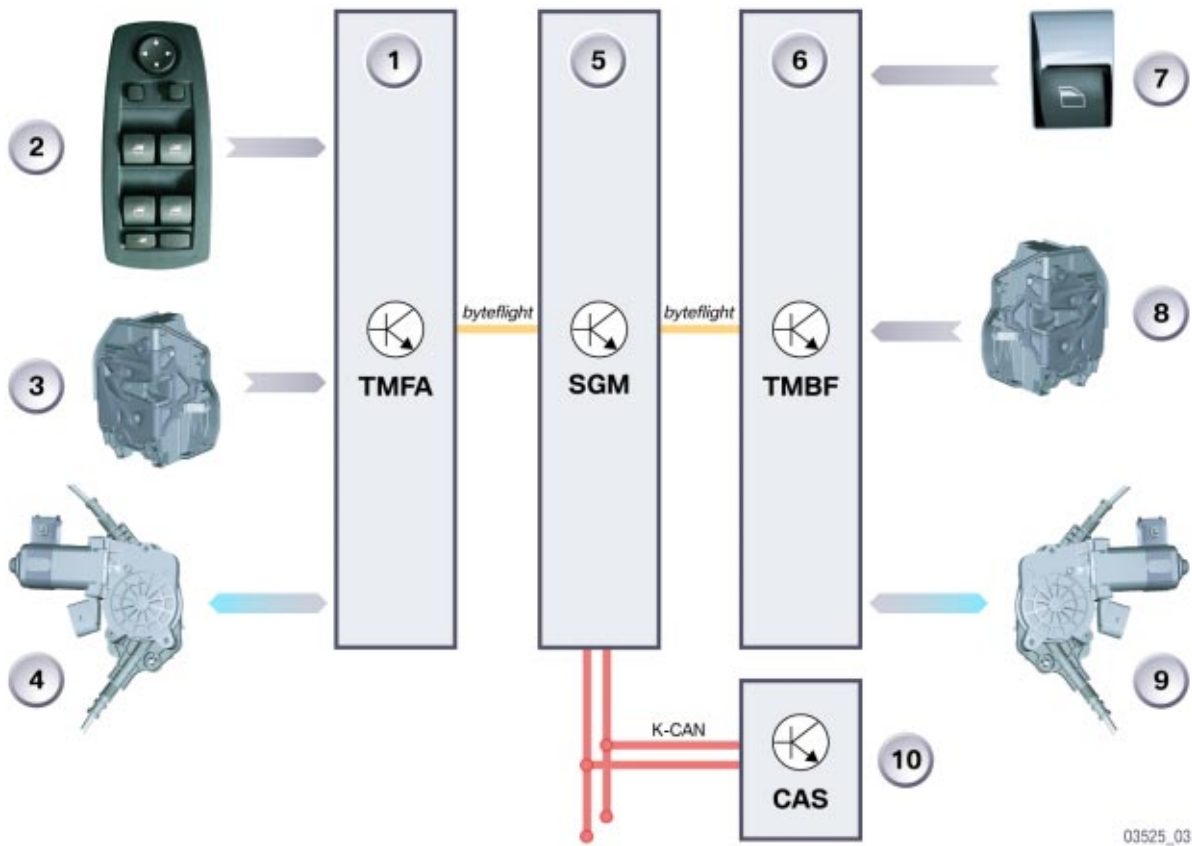
System Overview



Index	Explanation	Index	Explanation
1	Door Module, driver's side (TMFA)	10	Car Access System (CAS)
2	Driver's switch block module (SBFA)	11	Body Basic Module (KBM)
3	Driver's door lock actuator	12	Driver's side rear window switch
4	Driver's front power window motor	13	Driver's side rear door lock actuator
5	Safety and Gateway Module (SGM)	14	Driver's side rear power window motor
6	Door Module, passenger side (TMBF)	15	Passenger side rear window switch
7	Passenger door window switch	16	Passenger side rear door lock actuator
8	Passenger front door lock actuator	17	Passenger side rear power window motor
9	Passenger power window motor		

E63/E64 Changes from E60

The function of the power windows correspond to those of the E60. However, the rear windows are fixed and the corresponding pins of the KBM are not used. The E63/E64 does not use switches for the rear driver or passenger door (window). Also the power window motors and regulator assemblies are also deleted. Otherwise the operation of the power window circuits is the same as the E60.



Index	Explanation	Index	Explanation
1	Door Module, driver's side (TMFA)	6	Passenger door module (TMBF)
2	Driver's switch block module (SBFA)	7	Power window switch, passenger front
3	Door contact, driver's door front	8	Door contact, passenger front
4	Power window regulator, driver's front	9	Power window regulator, passenger front
5	Safety and Gateway Module (SGM)	10	Car Access System (CAS)

General Electrical New Features

KBM (Body Base Module)

The KBM controls the following functions:

- Rear Power Windows
- Central Locking (Rear Doors, Trunk/Tailgate and Fuel Filler Flap)
- Windshield Wiping/Wash System
- Interior Lighting
- Consumer Shutdown

Door Modules

The Door Module is integrated into the ASE. It communicates with other vehicle systems via the byteflight.

The Door Modules contain the following functions:

- Mirror Adjustment, Heating, Memory, Folding and Lighting
- Central Locking (Front Doors Only)
- Front Power Windows (with indirect anti-trapping)
- Connection to Driver's Door Switch Block
- Connection to Passenger's Door Power Window Switch)
- Door Entry Lights and Switch Illumination
- Recording of Front Door Pressure Sensor Information

CAS System

The Car Access System (CAS2) is based on the CAS of the E65, however in the E60 the ignition starter switch and the CAS are two separate components. The E60 CAS is connected directly to the K-Bus and does not perform any repeater functions.

PDC

The signal from the PDC button is forwarded to the PDC Control Unit via the K-CAN.

RDW (FTM)

E60 uses RDW (FTM) for low tire warning. Information concerning low tire is based on wheel speed and is received from the DSC.

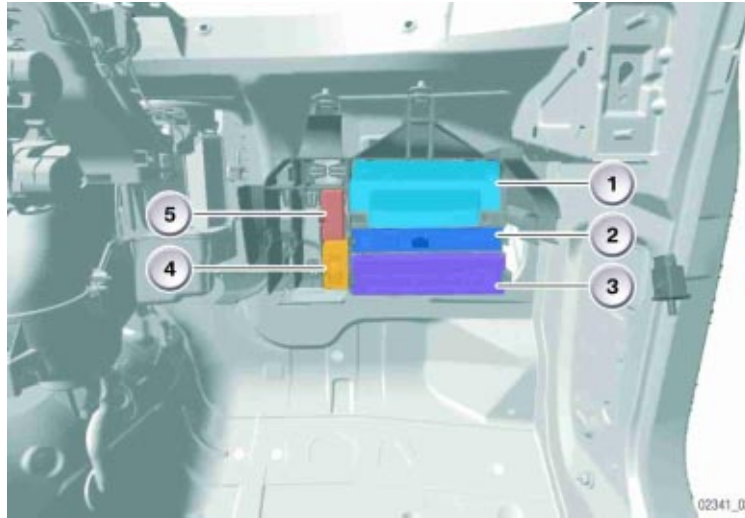
Roller Sunblind

The rear window roller sunblind is controlled from the center console switch panel. The roller sunblinds for the side windows are manually operated.

Multifunction Seat

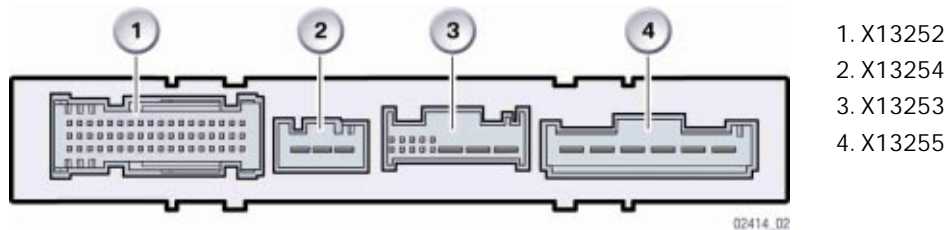
The multifunction seat makes it easier to get in and out of the vehicle. The backrest width and seat cushion depth are retracted for this purpose.

KBM



Index	Explanation	Index	Explanation
1	Compact Disc Changer (CDC)	4	Adaptive Headlights (AHL)
2	Body Basic Module (KBM)	5	Tire Pressure Control (RDC) Not for US
3	Safety and Gateway Module (SGM)		

Located in the equipment frame at the glove box, the KBM has 4 electrical connectors (X13252 54-pin, X13254 3-pin, X13253 13-pin, X13255 6-pin) and an operating voltage range of 9-16 Volts. The KBM is internally protected against shorts to terminal 30 or 31 and equipped with reverse polarity protection.



Power Windows

The front power windows are activated by the door modules of the respective door.

The rear power windows are activated by the basic body module KBM.

The power windows are operated as usual from the switch block in the driver's door (SBFA) and the switches in the other doors. Various safety functions and statutory requirements have been taken into consideration.

Switch Block SBFA

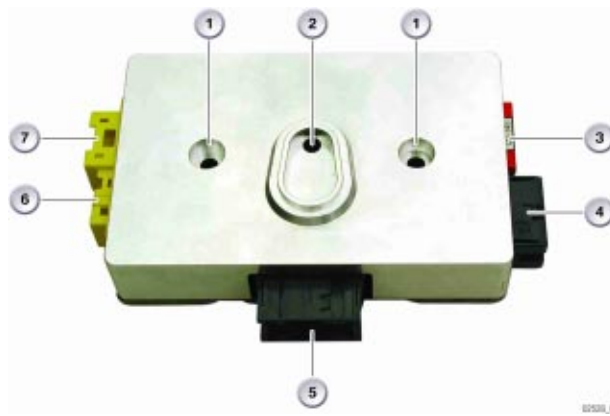
All the windows may be operated from the SBFA. The Switch Block passes all window requests to the TMFA via the LIN Bus.

LIN Bus

The LIN Bus is a sub bus allowing communication between the TMFA and the SBFA.

Door Modules

The door module contains separate "modules" for the door module electronics and the Advanced Safety Electronics.



Index	Explanation	Index	Explanation
1	Mounting holes	5	Connection for input signals
2	Input channel to pressure sensor	6	Connection for interior mirror
3	Connection for switch block	7	Connection for exterior mirror
4	Connection for power supply		

The door module is the interface between:

- Switch block, driver's door
- Switch, passenger side
- Door contact
- Incremental sensor in power-window motor
- bytflight
- Power-window motor

The driver's door switch block is linked to the driver's door module by means of an LIN-Bus. Control of mirror adjustment, heating and front area light is also integrated in the door modules.

The ASE system is integrated in the Door Modules. The door modules also incorporate the activation system for side air bag deployment.

The door module is powered with 10 V from terminal 30 and with 10V by the SGM. The 10 V supply is buffered for the function of the ASE system. When replacing the door module, bear in mind that the capacitor needs a few minutes to discharge. The airbag might be deployed if you replace the door module with the capacitor still charged.

byteflight

The ***byteflight*** bus system is involved in window operation as a method for door modules to communicate with the SGM.

SGM

The SGM converts and forwards messages to/from the byteflight and K-Can.

K-CAN

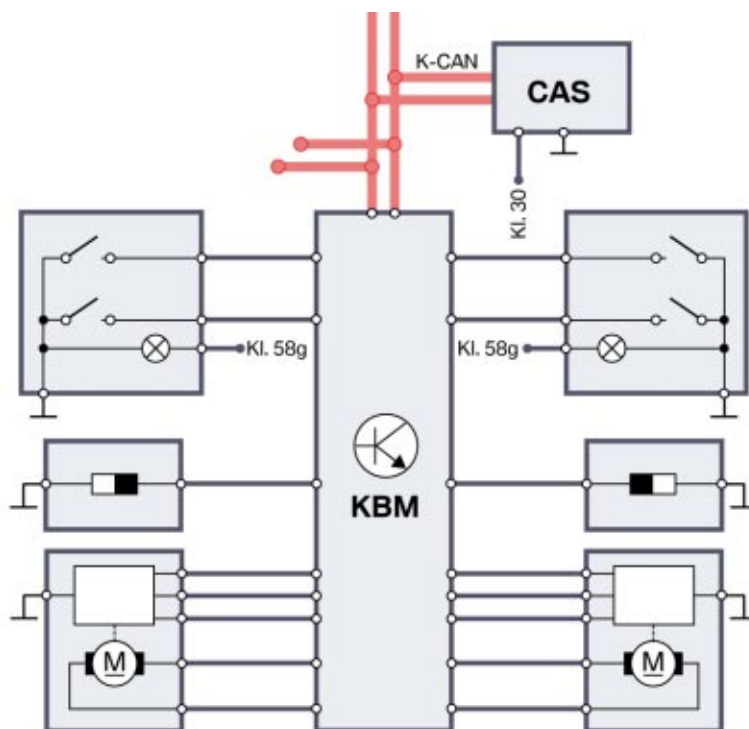
The K-CAN provides a communication path between the SGM, the CAS and the KBM as well as body modules.

KBM

The KBM receives input from the rear door window switches and the rear door contact switches and provides output to the rear window motors. The KBM also monitors the incremental sensor (hall sensors) in the rear window motors for position, speed and rotation.

Additionally the KBM allows also for contact and control of the rear windows through CAN communication with the SGM.

The KBM provides both power and ground to the rear window motors.



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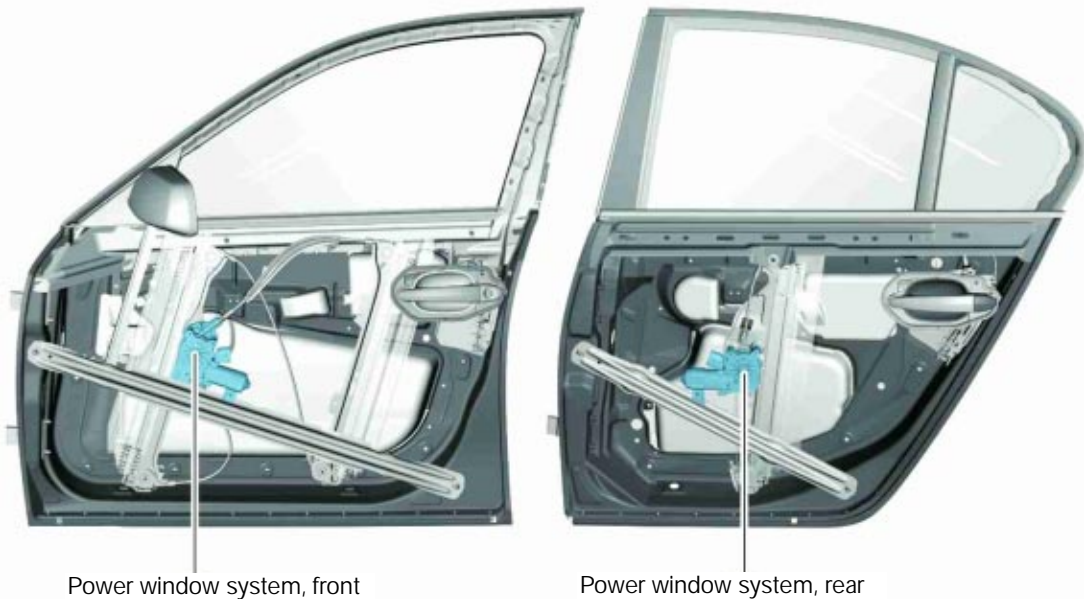
Power Window Motors

The drive mechanism of a power window lift is a cable lift mechanism consisting of:

- A DC motor
- A reduction gear with incremental sensor (Hall sensor)
- Evaluation Circuit
- A shrouded connection

The drive mechanism incorporates two Hall sensors, which are addressed by a magnet wheel mounted on the armature shaft.

The two Hall sensors and the magnet wheel determine with the aid of the door module or the KBM the direction of rotation, the speed and the position of the window.



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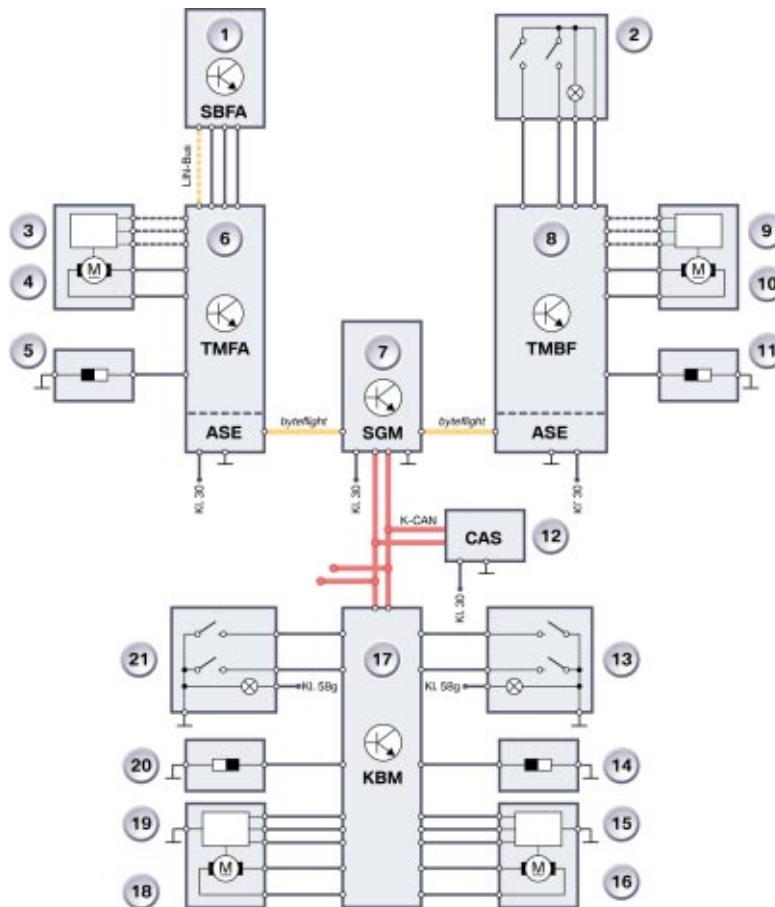
Door Contacts

The door contact switches, incorporated in the door latch mechanisms, provide door open/close data to the Door Modules/KBM.

CAS

The Car Access System control unit functions as the master for power window functions:

- Operation by radio remote control key
- Central-locking interface
- Country-specific programming
- Comfort functions (One-Touch)
- Child lock



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Index	Explanation	Index	Explanation
1	Driver's switch block module (SBFA)	12	Car Access System (CAS)
2	Passenger front door window switch	13	Window Switch, right rear
3	Hall sensor driver's door	14	Door contact, right rear
4	Driver's front power window motor	15	Hall sensor, right rear
5	Door contact driver's door	16	Window motor, right rear
6	Door Module, driver's side (TMFA)	17	Body Basic Module (KBM)
7	Safety and Gateway Module (SGM)	18	Window motor, left rear
8	Door Module, passenger side (TMBF)	19	Hall sensor, left rear
9	Hall sensor passenger door, front	20	Door contact, left rear
10	Passenger front power window motor	21	Window switch, left rear
11	Door contact passenger door front		

Operation

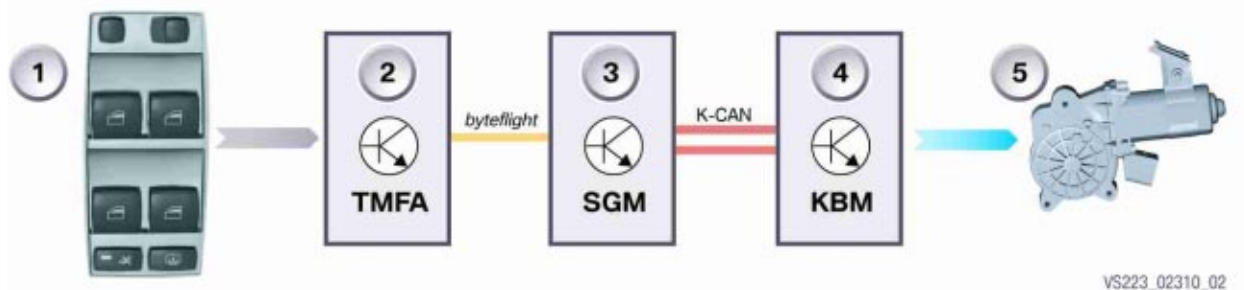
Opening of Passenger Front by Driver

The signal triggered in the SBFA when the button is pressed is sent via a LIN Bus to the TMFA. The TMFA sends the signal via the byteflight to the SGM.

The SGM converts the signal and sends it on the K-CAN to the CAS(the master for the front windows). The CAS evaluates the signal and sends a command to the SGM on the K-CAN. The SGM forward the command via the byteflight to the TMBF.

The TMBF receives the command for window movement, and a check signal from the Hall-sensor in the window motor and if necessary calculates indirect trapping protection. The window is then moved per the request.

Opening of Rear Window by Driver



Indirect Anti-Trapping

Anti-trapping protection is active over the entire window travel in the closing direction. Indirect anti-trapping protection does not eliminate trapping completely but rather restricts it to a maximum permissible trapping force.

For each subsequent closing operation, the currently required closing force is determined and compared with the stored value. If the difference between the two force values is over the specified trigger threshold, the direction of window movement is reversed immediately.

The reversing procedure is country and function dependent (emergency mode).

In order to ensure safe closing of the window glass, the drive mechanisms are briefly operated to their full extent when the zero position is reached at the upper stop.

Power-window anti-trapping protection has been developed in accordance with legal requirements in order to reliably prevent injury to vehicle occupants. When an object is detected in the path of the window, window travel is stopped and the window rolled down slightly.

Anti-trapping protection is deactivated by the emergency close function (panic mode). The control sequence is divided into two phases.

Phase 1

The closing position is overpressed until the emergency close mode is activated after a specific response time. The window is closed at maximum speed and with increased anti-trapping protection force. Anti-trapping protection remains activated even during emergency closing. If trapping is detected, the window is reversed only a short distance.

Phase 2

The button is released and overpulled again in 4 s. The window is now closed without anti-trapping protection with full force. In the event of blocking, the power-window motor is supplied with power until thermal protection is engaged.

In the event of faulty anti-trapping protection, there is the option of emergency-closing the windows.

If fully operational anti-trapping protection cannot be detected, e.g. faulty sensors, automatic operation is not permitted.

Power Detection

The system adapts itself to changes in the weather and environmental influences. The closing force is recorded by indirect sensors (Hall sensors) and limited accordingly.

Initialization of Power Windows

Front Windows	Rear Windows
<p>On Initial start-up, only the upper window stop has to be learned. For this purpose the window must be held for 500ms at the upper stop position.</p> <p>A characteristic curve is not learned for the front windows. The lower stop does not have to be approached. In order to compensate for mechanical aging, an automatic readjustment of the end position is performed cyclically at the upper stop.</p> <p>Move window to full closed position and hold for at least 500ms.</p>	<p>The rear windows must be initialized.</p> <p>During the initialization the end positions of the window travel are determined by limit runs into the upper window seal and to the lower window stop.</p> <p>Move window to full closed position and hold for at least 500ms.</p> <p>Move window to lower window stop and hold for 17 seconds.</p> <p>Move window to full closed and continue to hold the switch in the window closing direction.</p> <p>The Window will open the close to confirm proper initialization.</p> <p>Note: This procedure is the same as E65.</p>



Workshop Exercise - Power Windows

Using an instructor designated vehicle, perform the following operations as directed.

Using proper repair instructions in WebTIS, remove drivers side door panel. Using the proper test cables, obtain the correct scope pattern of the LIN-Bus signal from the switch assembly to door module.

What is the observed voltage range of the LIN Bus?

Using the appropriate test cables, create a short circuit to ground on the LIN-Bus.

What is observed when the LIN Bus is grounded? (failures, fault codes etc.)

Using the appropriate test cables, create a short circuit to B+ on the LIN-Bus.

What is observed when the LIN Bus is shorted to B+? (failures, fault codes etc.)

Perform Initialization on front windows. List proper steps and relevant observations.

Perform Initialization on rear windows. List proper steps and relevant observations.

Check the anti-trap feature on both the front and rear windows.

Is the anti-trap closing force approximately the same on both the front and rear?

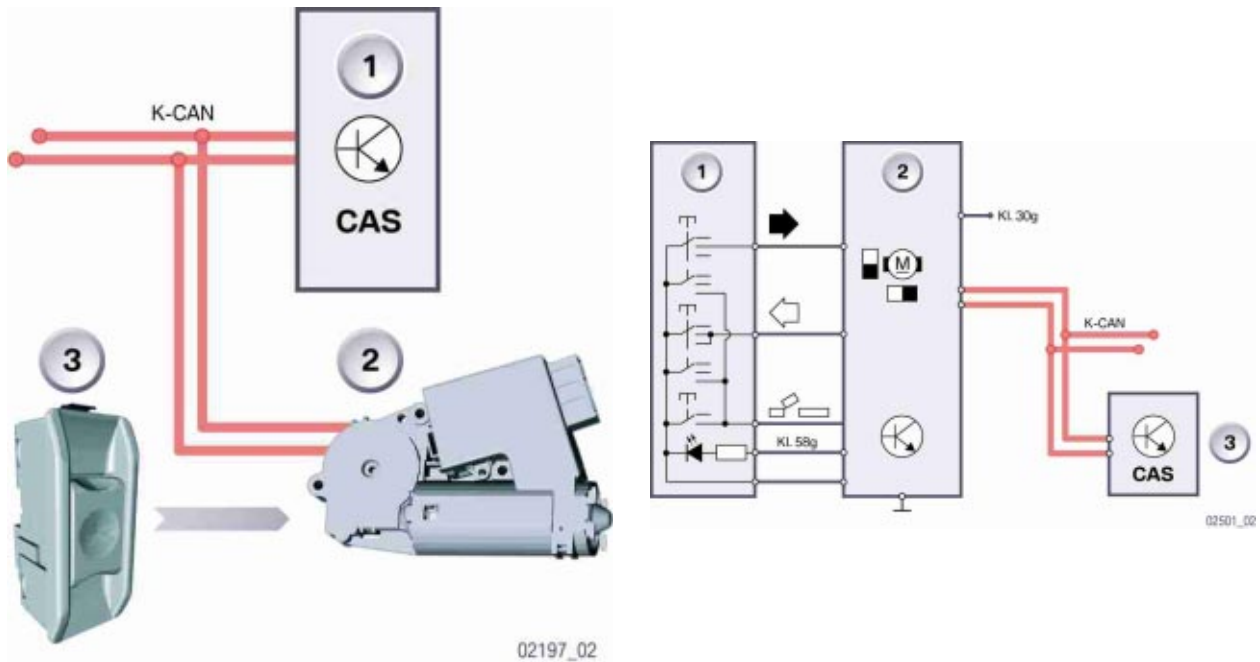
Is the anti-trap closing force the same for the entire window travel?

Perform the anti-trap test again quickly after performing the test a first time.

Is the closing force the same as on the first test?

Notes:

Slide/Tilt Sunroof



1. Car Access System (CAS)
2. SHD module with integrated electronics
3. Sunroof switch

1. Sunroof switch
2. SHD module with integrated electronics
3. Car Access System (CAS)

Slide/Tilt Sunroof Push-Button

The push-button for the slide/tilt sunroof (SHD) switches to ground. The power supply of the push-button features polarity reversal protection and is disconnected from the power supply in the event of overvoltage and in sleep mode.

Slide/Tilt Sunroof Module

The SHD module controls and monitors the electric motor and therefore the movement of the slide/tilt sunroof. The commands the driver selects with the push-button are transferred directly to the slide/tilt sunroof module.

Communication with the vehicle is controlled via the K-CAN. The SHD module receives information relating to terminal 58g via the K-CAN from the light module. The SHD module controls the LEDs of the SHD push-button. Terminal 58g has a clock cycle of 200 Hz for the purpose of dimming the lighting.

Car Access System

The CAS contains the master function for auto-remote opening.

Functions

Panic Mode

Panic Mode is triggered by pressing and holding the SHD button in the 2nd notch position.

With this function, the sunroof is closed without anti-trap or closing force limitation protection. Panic close is possible only at speeds under 16 km/h.

Emergency Operation

In Emergency Mode, the sunroof only moves for 750ms at a time. The emergency function is only available when the CAS has signaled the SHD control module, "Emergency Mode Enable", via the K-CAN.

Emergency operation is active under the following conditions:

- Coding Invalid
- Defective Hall-sensor
- Initialization incomplete

If initialization is incomplete operation is permitted based on scaling or characteristic curves.

With no scaling, movement is allowed only in the direction of the scaling position.

With no characteristic curve learned, movement is only in the closing direction.

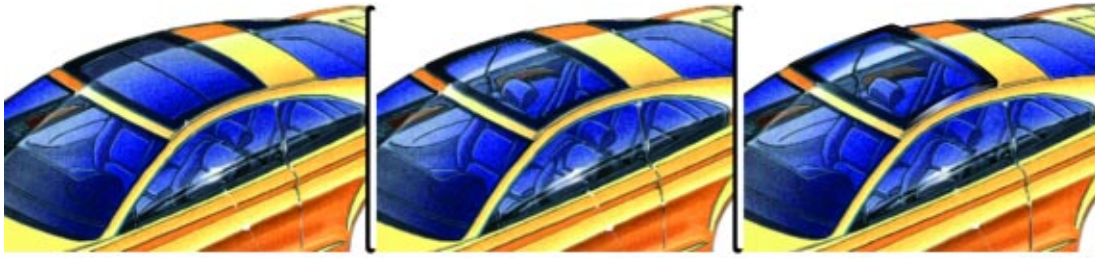
Initialization

Initialization of the Sunroof is performed as follows:

- Press the operating switch to the "Lift" position and hold.
- After 15 seconds, the sunroof will "Lift". Continue to hold the switch.
- After approximately 5 seconds the sunroof will close. Continue to hold the switch.
- The sunroof will then open completely and close completely.
- If the switch is released at any time during the procedure the operation must be repeated.

Note: Anti-trapping protection does not function during the initialization process.

E63 Glass Tilt Sunroof



Changes Compared to the E60

Instead of the slide/tilt sunroof, the E63 features a glass tilt sunroof. The sunroof visor is two-piece. Two motors are installed for operating the glass tilt sunroof. The system differs in design from the standard SHD, the Multi-Drive Sunroof module (MDS) contains the operating electronics for the sunroof motors (2). The MDS and the sunroof motors are separate components rather than the integrated style of the SHD.

System Components

The following components relating to the glass tilt sunroof are fitted in the vehicle:

- Control button for glass tilt sunroof
- Control unit, multi-drive sunroof MDS, for glass tilt sunroof
- Motor for glass tilt sunroof
- Motor for sunroof visor

Communication with other users in the vehicle, such as the Car Access System (CAS), takes place via the K-CAN.

Control Unit MDS

The MDS is installed in the carrier in the glove compartment.

Functions

Control Button

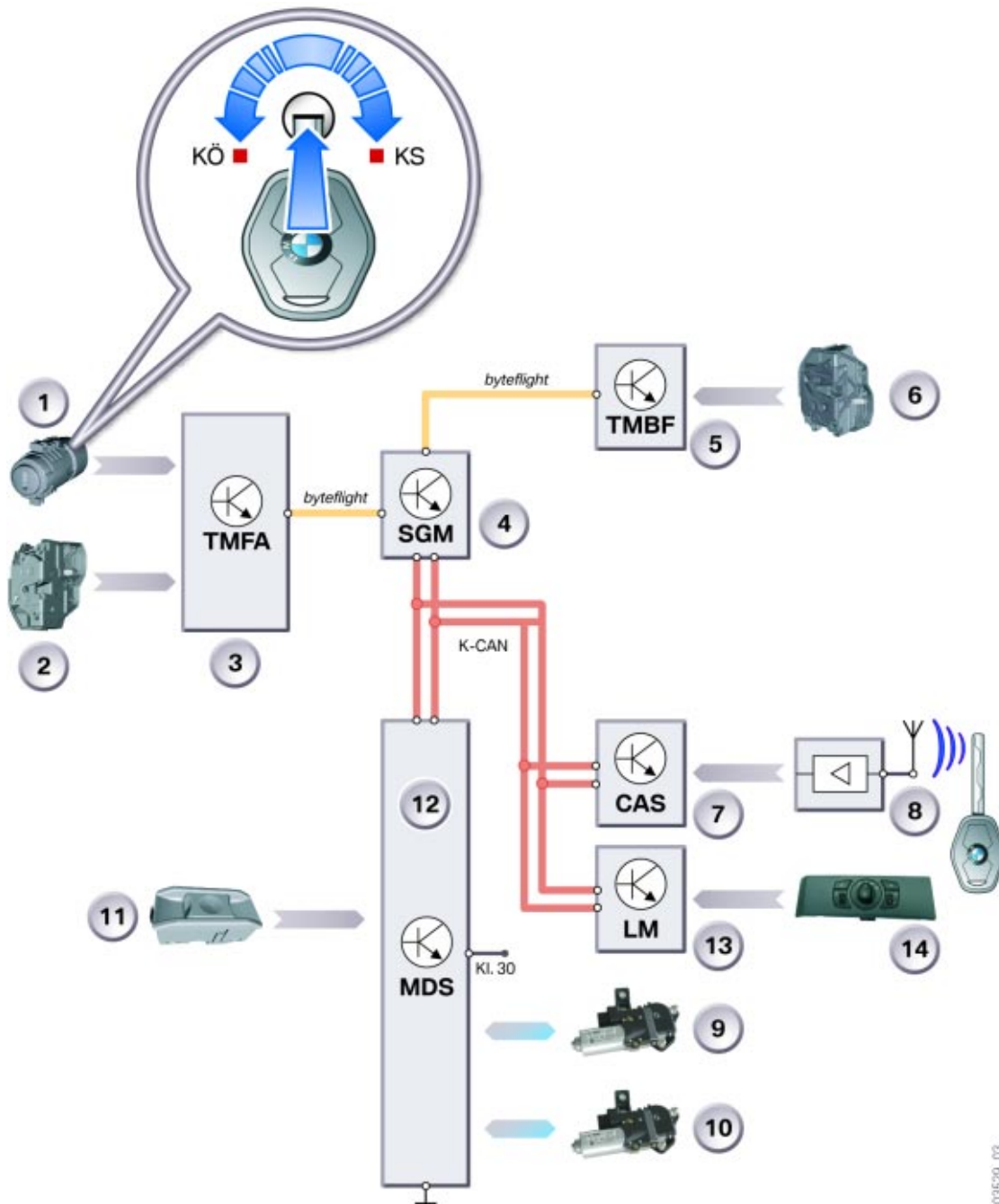
The button functions are described in the Owner's Handbook.

Glass Tilt Sunroof

The functions of the glass tilt sunroof are based on the tilt functions of the E60 slide/tilt sunroof.

Sunroof Visor

The functions of the sunroof visor are based on the functions of the sunroof visor for the panoramic glass sunroof



Index	Explanation	Index	Explanation
1	Lock cylinder, driver's door	8	Car Access System (CAS)
2	Door contact, driver's door	9	Motor for glass tilt sunroof
3	Driver's door module (TMFA)	10	Motor for sunroof visor
4	Safety and Gateway Module (SGM)	11	Sunroof switch
5	Passenger door module (TMBF)	12	Multi-Drive Sunroof module (MDS)
6	Door contact, passenger side	13	Light Module
7	Cas Access System (CAS)	14	Light Module control switch

Service Information

Initialization

Initialization of the glass tilt sunroof is based on that of the E60. The glass tilt sunroof can be initialized either via the control button or the tester.

Only full initialization will ensure complete operability of the glass roof.

Manual Initialization with Control Button

The characteristic curve is relearned during every new or re-initialization of the glass tilt sunroof.

Preconditions

The glass sunroof must be clean and be at room temperature. Terminal 15 ON must be applied. When the glass tilt sunroof is subsequently initialized using the control button, this button must remain pressed until the initialization procedure is concluded.

The control button is pressed and held in the lift sunroof direction. The initialization run starts up approximately 15 seconds after pressing the control button.

Glass Tilt Sunroof

The glass tilt sunroof can be replaced only together with the sunroof visor.

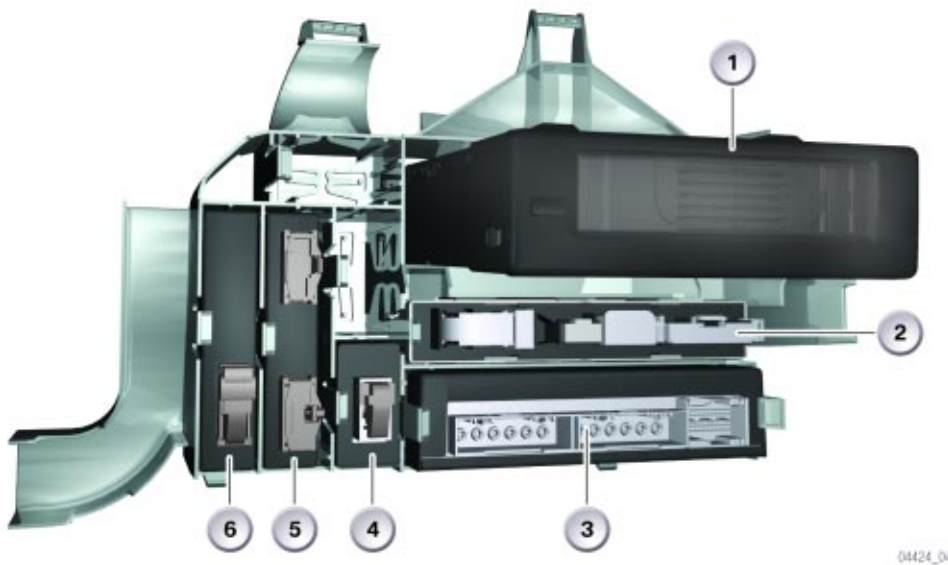
The motors and the control unit can be replaced individually. The MDS module must be encoded and initialized after replacement.

E61 Panorama Glass Sunroof

The panorama glass sunroof in the E61 is the same as the panorama glass sunroof on the E53 and the E83. The functional principle is therefore only briefly mentioned here.



The Multi Drive Sunroof module (MDS) controls and monitors the electric motors and therefore the movement of the panorama glass sunroof. The MDS is installed on the carrier behind the glove compartment.



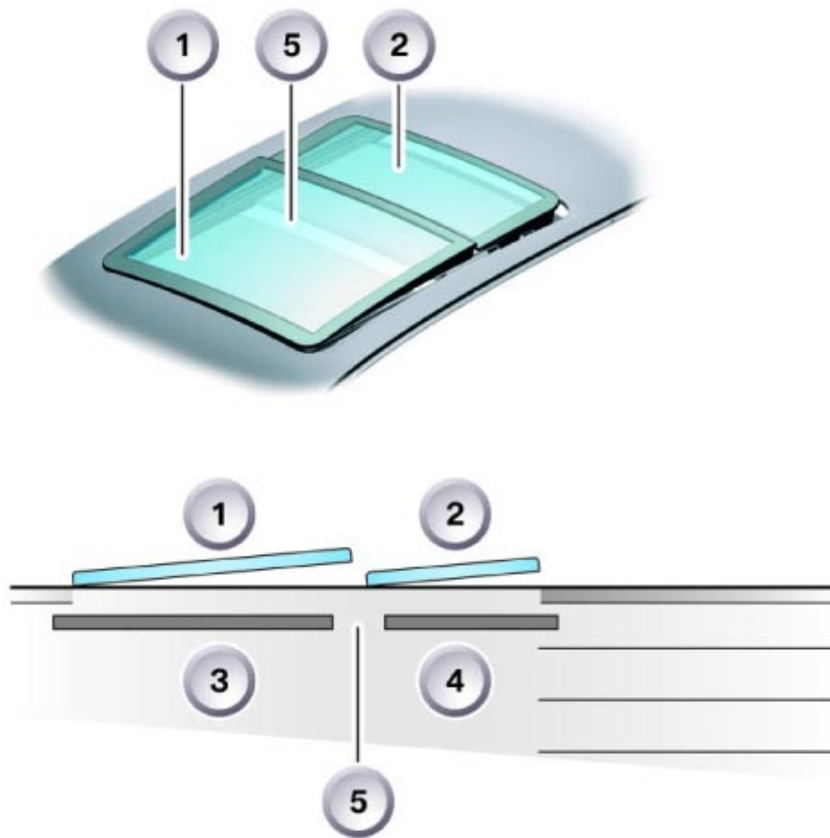
Index	Explanation	Index	Explanation
1	CD Changer (CDC)	4	Adaptive Headlight Module (AHL)
2	Body Basic Module (KBM)	5	Multi Drive Sunroof Module (MDS)
3	Safety and Gateway Module (SGM)	6	Passive Go (Comfort Access)

Functions of the Control Button

The control button has three directions of movement. There are therefore three different functions available: a manual function, a pressure-point function and a double-click function. The double-click function is when the control button is pressed beyond the pressure point or to the raise position twice in quick succession. This allows the customer to open or close the panorama glass sunroof automatically regardless of its current position.

The current movement of the panorama glass sunroof can be stopped by pressing the control button in the opposite operating direction. The panorama glass sunroof control button switches to earth and is supplied with power from terminal 58g via the MDS.

Panorama Glass Sunroof Functions



Index	Explanation	Index	Explanation
1	Slide/tilt glass roof panel	4	Rear Visor
2	Tilt glass roof panel	5	Visor Gap
3	Front visor		

Initial status: both glass roof panels and both visors closed.

To Open Sunroof Visor

Press "OPEN" once

- Signal from switch to control unit
- Control unit activates rear motor
- Rear motor opens both visors
- Roof panel remains closed

To Open Sunroof Visor and Roof Panel

Press "OPEN" twice (double-click)

- Signal from switch to control unit
- Control unit initially activates rear motor
- Rear motor opens both visors
- With a time offset, control unit activates front motor
- Front motor opens front roof panel
- Rear motor raises wind deflector

Tilt Position

Press "TILT" once

- Signal from switch to control unit
- Control unit activates both motors
- Front motor tilts both roof panels
- Rear motor moves both visors to gap position (vent position)

To Close Roof Panels

Press "CLOSE" once

- Signal from switch to control unit
- Control unit activates front motor
- Front motor closes both roof panels

To Close Sunroof Visor and Roof Panel

Press "CLOSE" twice (double-click)

- Signal from switch to control unit
- Control unit initially activates front motor
- Front motor closes both roof panels
- With time delay, control unit activates rear motor
- Rear motor closes both visors and releases the wind deflector so that the roof panel can press it down.

To Close Sunroof Visor

(only possible with roof panel already closed)

Press "CLOSE" once

- Signal from switch to control unit
- Control unit activates rear motor
- Rear motor closes both visors

Speed Control of Wind Deflector with Roof Open

As from a driving speed of 140 km/h, the control unit receives a speed signal from the DSC control unit. The control unit then activates the rear motor that releases the wind deflector (motor turns only slightly, the sunroof visors do not move). As a result, the wind deflector is pressed into a lower position.

Toll Operation

All control functions are also available as toll functions (comfort functions). They are activated by pressing beyond the switch notch.

- Open sunroof visor only
- Open sunroof visor and roof panel (up to comfort setting)
- Roof panel tilt position and visor vent position
- Close roof panel only
- Close roof panel and sunroof visor
- Close sunroof visor only with roof panels already closed

Convenient Opening and Closing via Key

The roof can also be operated by pressing and holding the remote control in "open" or "close" direction.

Initialization

- Press switch in tilt position
- Both roof panels move to tilt position, both visors move to vent position
- Press and hold switch for 15 seconds
- Initialization begins (keep switch pressed)
- Both sunroof visors open
- Both roof panels are lowered
- Both roof panels open and close again
- Both sunroof visors close
- Release switch, panorama glass sunroof is initialized

Anti-trapping Circuit

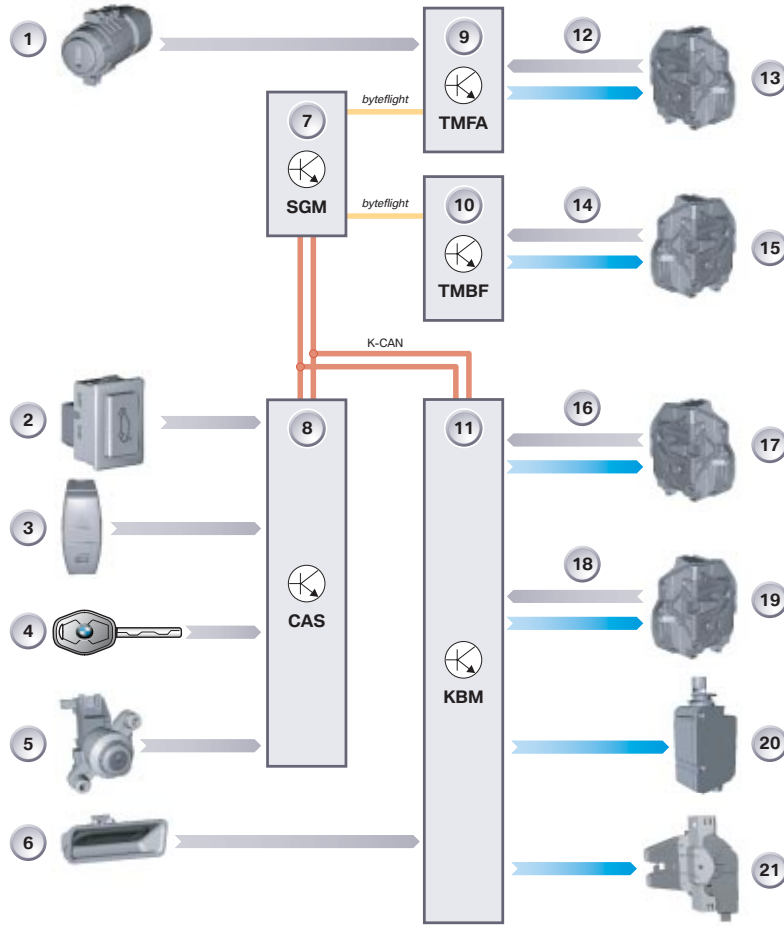
Both the roof panels as well as the sunroof visors are equipped with an anti-trapping circuit. If the control unit recognizes a trapping situation, the corresponding motor is stopped and driven in the opposite direction.

As a result, the roof panel or sunroof visor opens again (approximately. 15 cm) releasing the obstruction.

Central Locking System

The central locking system involves the actuation/evaluation of the doors, trunk and fuel filler flap. The central locking functions of the doors are equipped with double lock functions and operate in accordance with the two-motor principle.

The door modules control the central locking functions of the front doors. The KBM controls the central locking in the rear area.



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Index	Explanation	Index	Explanation
1	Lock cylinder, driver's door	12	Door contact, driver's door
2	Trunk release button, interior	13	Central locking , driver's door
3	Central locking button	14	Door contact, front passenger door
4	Remote control (key)	15	Central locking, passenger door front
5	Lock cylinder, trunk/tailgate	16	Door contact, rear driver's side door
6	Trunk release button , exterior	17	Central locking, rear driver's side door
7	Safety and Gateway Module (SGM)	18	Door contact, rear passenger side door
8	Car Access System (CAS)	19	Central locking, rear passenger side door
9	Driver's door module (TMFA)	20	Central locking, fuel filler flap
10	Passenger door module (TMBF)	21	Central locking, tailgate
11	Body Basic Module (KBM)		

The central locking system consists of the following control inputs:

- Driver's door lock cylinder
- Center-lock button
- Remote control key
- Trunk lock cylinder

The system can be additionally unlocked via the crash sensor and forced release is possible by means of the "key inserted" signal in the CAS. A function is triggered when a status change at the respective input is detected. If several new ZV commands are given while a command is being carried out, only the last command will be subsequently executed.

The CAS is the central locking master and is responsible for enabling all central locking procedures in the vehicle.

The central locking can assume following statuses:

Status	Explanation
Unlocked	All locks are in the unlocked position. outer and inner door handles are operational.
Selective Unlocked	The driver's door in unlocked. All other locks are in the lock position.
Locked	All locks are in the lock position. Outer door handles are not operational. Inner door handles are operational
Secured	All locks are in the lock position. Inner and outer door handles are not operational.
Opened	At least one lock is in the unlocked position.

Secure Lock (Double Lock)

The secure lock function (locking of the vehicle from the outside using either the remote or the drivers door lock cylinder) uses a mechanical coupling to uncouple the locking pin of the door from the lock. The vehicle can then no longer be opened by the following actions:

- Pulling the locking buttons
- Pulling the inner door handle
- Pulling the outer door handle
- Pressing the center-lock button

Secure lock is only possible:

- At terminal R off and key not inserted
- After opening and closing the driver's door or Opening the passenger's door

No action takes place following the secure lock request when the driver's door is open.

A secure locked (secured) vehicle cannot be unlocked via diagnosis functions.

A secure locked (secured) vehicle can be changed to "Lock status" by pressing the center console lock button (CLT).

The vehicle lock status is changed from secure to unlocked when the CAS recognizes a valid transponder key has been inserted.

Automatic Locking

If the system is not yet locked or if a door was opened with the ZV locked, a lock command is executed on exceeding a speed of 16 km/h.

Crash Unlock

In the event of a crash, the safety and gateway module (SGM) releases the central locking system (ZV) via the bus network at terminal R or 15.

The ZV assumes "crash mode" even when the central locking was already unlocked.

Crash unlock is disabled when the vehicle status is secure lock.

Crash mode is released when an unlock/lock request is made. This corresponds to deactivation of crash mode.

Power on Status

The central locking status does not change by disconnecting and reconnecting the supply voltage. There is no reaction if command inputs are active while reconnecting the supply voltage (reset).

DWA - Central Lock Interface

The anti-theft alarm system DWA is not an integral part of the central locking system, however, it requires commands and signals from this system. The central locking system (ZV) monitors the status of the doors, hood, trunk, fuel filler flap and terminals. The DWA monitors the tilt alarm sensor (NG) as well as the ultrasonic interior protection system (USES).

The DWA is armed by means of any valid ZS command from an authorized control point or via the remote control. An LED provides an optical signal of the DWA status.

The tilt alarm sensor and interior protection are switched off if a ZS command is initiated within 3 s after initially arming the DWA.

The luggage compartment is accessible without triggering alarm even when the DWA is armed via the remote control. An alarm is triggered if the lock cylinder on the trunk is operated mechanically with the DWA armed.

Remote Control FBD

Evaluation of the logic remote control (FBD) signals is integrated in the CAS control unit. In addition to various other functions, the central locking functions that can be coded in the key memory can be selected "personalized" in the CAS control unit.

It is possible to actuate the central locking by means of a second remote control with the key inserted.

Different personalized functions can be selected depending on the type of remote control key used. The functions "selective ZV", "lock as from 16 km/h" as well as "lock after 2 minutes" can be coded in the CAS.

The remote control number identifies the key on which the "unlock" button was last pressed. Irrespective of this function, the currently used key is always identified as the control point in connection with the "unlock trunk" function.

Trunk Locking

The trunk can be unlocked and opened via:

- Radio remote control FBD
- External trunk button on boot lid handle
- Internal trunk button in driver's footwell
- Lock cylinder on trunk; purely mechanical

Hotel Setting

The hotel setting is initiated via the lock cylinder of the trunk. The following control points are deactivated when the hotel setting is initiated:

- Trunk button via remote control
- Exterior trunk button
- Interior trunk button

The trunk remains locked even when the vehicle is unlocked. The hotel setting is indicated to the customer by means of the switch position.

The push-button on the trunk is therefore only active when the vehicle is unlocked and stationary and not when the hotel setting is initiated.

The interior button is additionally active even when the vehicle is locked but only up to the specified speed threshold.

The system can always be unlocked via the remote control with the ignition key removed without the hotel setting engaged.

Automatic Relock

The central locking unlocks (selective or global, corresponding to coding) when a release command is triggered inadvertently via the remote control. If no door or hood/trunk is opened within 2 minutes, the central locking reassumes the locked status in connection with the coding "automatic relock."

Car & Key Memory

The central individualization elements are the coding data of the vehicle. Certain codeable functions are enabled for the car memory as part of the individualization procedure.

In connection with the personalization, individual functions depending on the vehicle key, maximum 4, used to unlock the system, are also controlled for the central locking. Otherwise the central locking operates in accordance with the coded basic setting.

The central locking functions therefore depend on the personalization of the 4 vehicle keys and on the standard coding for the vehicle.

Codeable Key Memory Functions

Coding	Description
Automatic relock	Relock after 2 minutes
Speed lock	Lock from 16 km/h
Selective unlock	Only if the driver's door is unlocked

Codeable Car Memory Functions

Coding	Description
Terminal R prohibits trunk operation	The trunk is not opened when terminal R is engaged
Unlock on removing key	The vehicle unlocks after the key is removed if the system was locked via the speed lock or terminal R lock.
Crossover operation disabled	A vehicle locked via the remote can not be unlocked with the key.

Windshield Wiping/Washer System

The wipe/wash system is a conventional wipe/wash system with reset contact. All wipe/wash functions can be activated with the wiper switch once terminal R is on. The rain and light sensor (RLS) is fitted as standard. Wiper system functions are vehicle speed dependent.

To reduce noise and wear, the load circuit of the wiper motor has been designed as an external double relay. The wipers are driven by an electric motor with a reducer gear. A transistor is integrated in the body base module (KBM) for the washer fluid pump.

The wiper blades have a new method of attachment to the windshield-wiper arm.

The wash/wipe system no longer has ball-and-socket type washer jets. Instead, fan-type jets are used (fluidic jets).

The washer jet heater is controlled by the IHKA module. And a headlight cleaning system is offered as an option

The Touring (E61) has a rear window wiper with a separate rear window washer pump as standard.

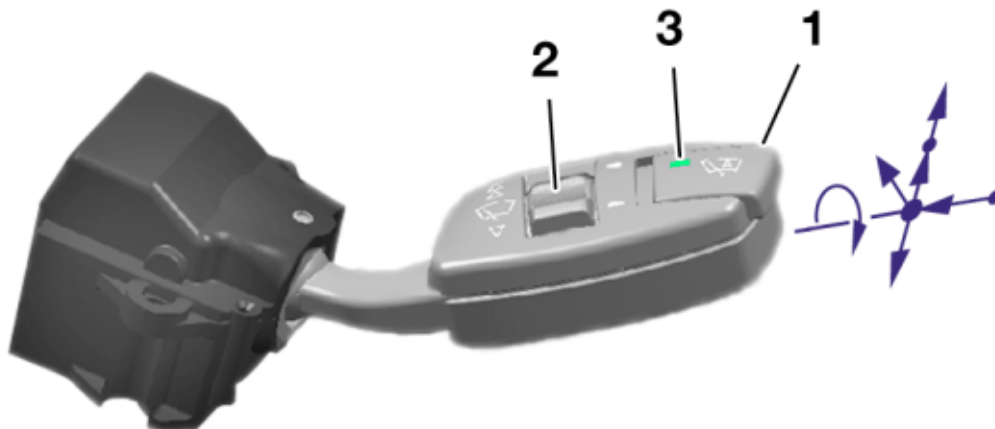
System Components

Wiper Switch

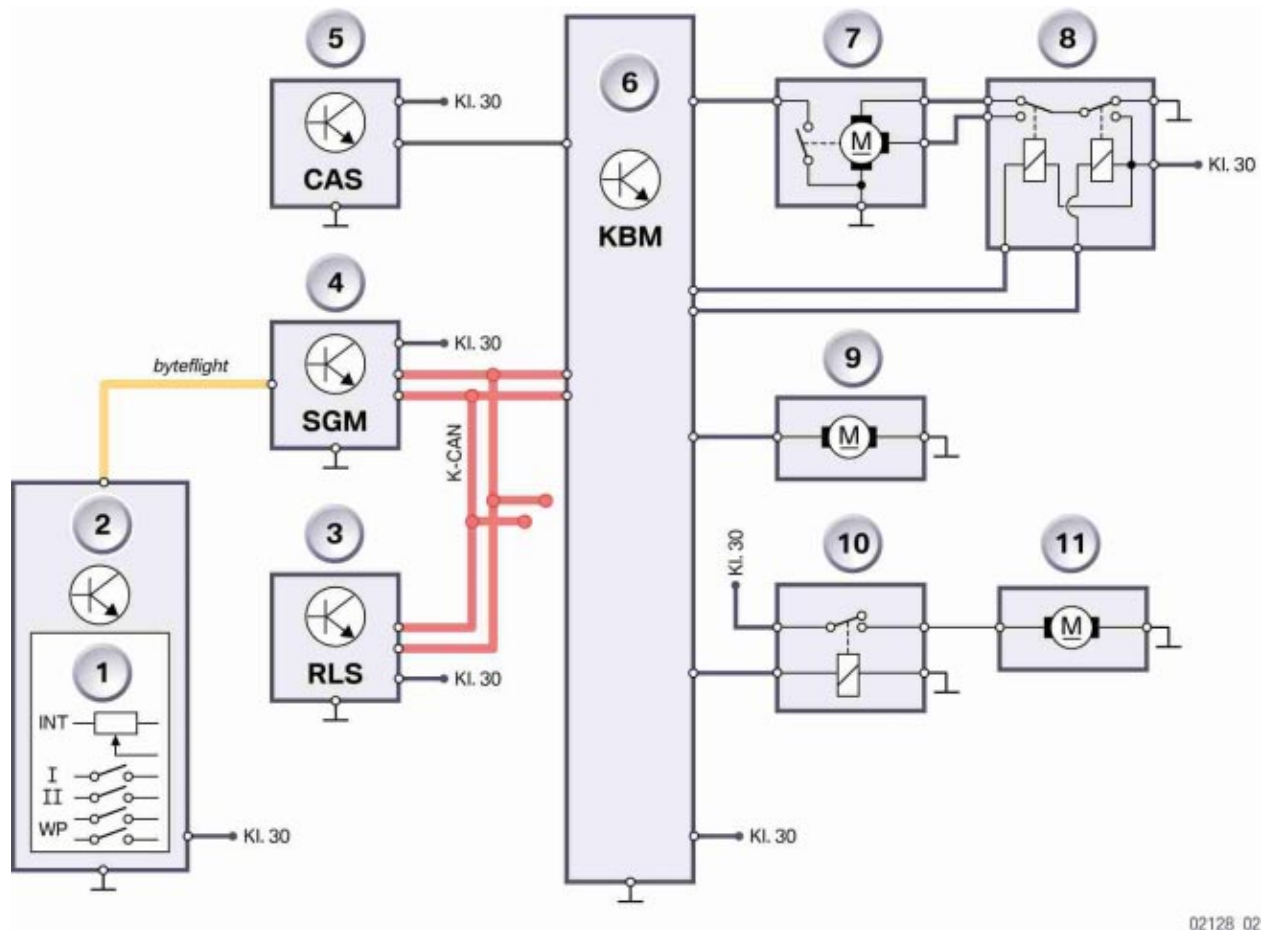
The wiper switch is operated by a brief press (similar to E65). The wiper switch does not lock into place.

The signal from the wiper switch is passed on by the steering column switch cluster (SZL) to the Safety and gateway module (SGM). The SGM transmits the signal to the KBM.

The axial switch on the end of the wiper switch is used to activate automatic mode (automatic control of wipers by rain/light sensor). When automatic mode is not active, intermittent wiper mode is controlled according to vehicle speed.



Wiper System Overview



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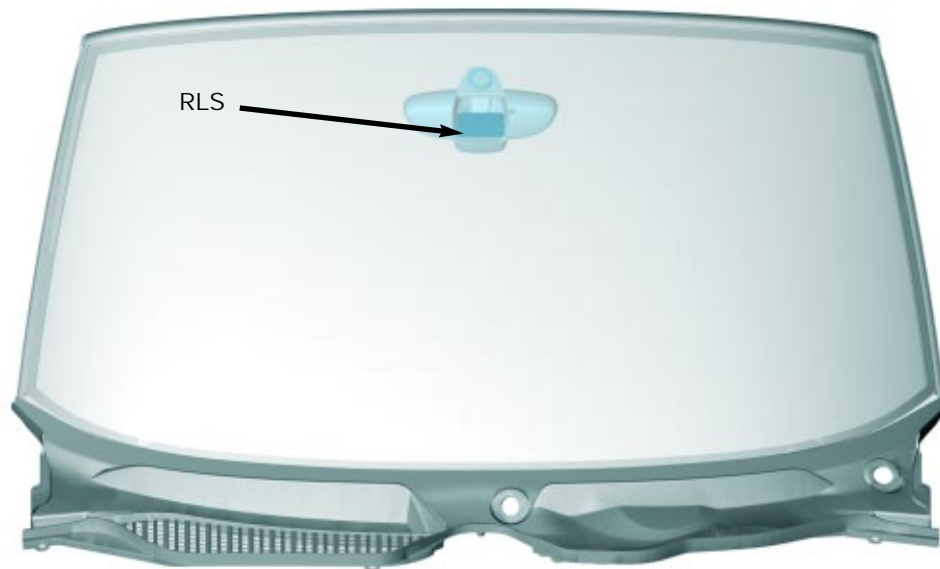
Index	Explanation	Index	Explanation
1	Steering Column Switch	7	Wiper Motor
2	SZL	8	Wipe/Wash Relay
3	RLS	9	Washer Fluid Pump
4	SGM	10	SRA Relay
5	CAS	11	SRA Pump
6	KBM		

Rain and Light Sensor (RLS)

The rain/light sensor is integrated in the rear-view mirror pedestal attached to the windshield. The RLS is a combined rain sensor and ambient light sensor. It detects the amount of rain falling on the windshield in order to control the windshield wipers, and the level of ambient light in order to control the headlights.

The rain sensor sends the "Switch on wipers" request to the body basic module (KBM) via the body CAN-Bus (K-CAN).

If the rain and light sensor should fail or be faulty, the KBM will take control. The KBM will switch to an emergency mode. Emergency mode is a speed-dependent intermittent mode.



Safety and Gateway Module

The SGM switches the wiper switch signal from the byteflight to the K-CAN via SZL.

Steering Column Switch Cluster

The steering-column switch cluster (SZL) forms the interface between the wiper switch and the Safety and gateway module (SGM). The signals are transmitted via the byteflight data bus.

Integrated automatic heating and air-conditioning system

The integrated automatic heating and air-conditioning module (IHKA) controls the washer-jet heating system.

Body Basic Module (KBM)

The body basic module (KBM) receives all the information that is required for operation of the wipe/wash system.

The body base module activates the following components:

- Dual relay module for the wiper motor
- Relay for the headlight cleaning system
- Washer fluid pump

The KBM also controls the wash/wipe system on the Touring (E61) which also includes the wash/wipe system for the rear window).

The body basic module is connected via the K-CAN and communicates with the:

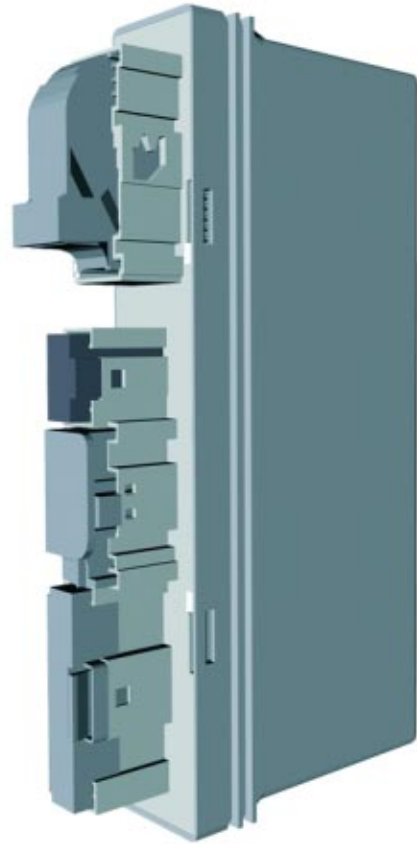
- Safety and gateway module (SGM)
- Rain-light sensor (RLS)
- Integrated automatic heating and air conditioning system (IHKA)

The following systems are outputs/actuators of the wiper/washer system:

Wiper Motor

The wiper system is a twin-arm synchronous system with reciprocating action (four-bar linkage). The motor is a rotary motor without an electronic module and is controlled by KBM via a double relay.

The wiper motor's end position (off position) is detected by a reset contact integrated in the wiper motor. The crank is permanently connected to the wiper motor.



Touring (E61)

The rear window wiper motor is mounted on the rear window and is controlled by the KBM via a relay.

The rear window wiper motor's end position (off position) is detected by a reset contact integrated in the wiper motor.

Windshield and Rear Window Washer Pump (on the Touring)

Both washer pumps are attached to the washer fluid reservoir. The washer pumps are controlled by the KBM. The washer jets are not adjustable. The new-design washer jets (fluidic jets) produce a pulsating, fan-shaped jet of fluid.

Headlamp Washer Pump

The headlamp washer system is an option. The option includes a washer fluid reservoir which holds 5 liters instead of 3 liters. (Note: the Touring reservoir always holds 5 liters).

The headlamp-washer pump is mounted on the washer-fluid reservoir. The washer pump is controlled by the KBM via a relay.

Heated Washer Jets

The washer-jet heater system prevents the washer jets freezing in cold weather.

The washer-jet heater system is controlled by the IHKA module on the basis of outside temperature ($< 3^{\circ}\text{C}$). The washer-jet heating system consists of heating resistors.

System Functions

The wash/wipe system incorporates the following functions:

- Wiper functions
- Windshield and rear window wash function (on the Touring)
- Headlight washer function
- Safety function

Wiper Functions

The windshield-wiper functions are available as soon as Terminal R status is ON. The following wiper functions are provided (see also wiper switch system):

- Flick wipe (one-wipe)
- Intermittent wipe
- Wiper speed 1
- Wiper speed 2
- Automatic wipe controlled by rain-light sensor

Touring (E61)

The rear window is wiped intermittently (the customer can program the duration of the intervals, see Owner's Handbook).

No wiper operation is allowed when the rear window is open (via rear window contact switch).

When reverse gear is engaged intermittent operation switches to constant wiping.

Windshield and Rear Window Wash Function (on the Touring)

The windshield-washer functions are available as soon as Terminal R status is ON.

To operate the windshield washer, the wiper switch is pulled backwards (towards driver).

Touring: To wash the rear window, the wiper switch must be pushed forwards (away from the driver) (speed 2).

The washer pump continues running as long as the switch is held in that position. If the wiper switch is operated only momentarily (< 300 ms), only the washer pump switches on. If the switch is held in position for longer, the wipers come into action after a short delay. After the washer pump has switched off, the wipers complete three more wipes to dry the windshield.

Headlamp Washer System

When the low beams headlights are switched on, the headlamps are washed every 10th time the windshield washer is operated.

After ignition ON and dipped beam headlights ON:

The headlamps are cleaned at the same time as the first wash movement for the windshield.

Wash-cycle sequence:

- 0.7 seconds ON
- 1.3 seconds OFF
- 0.7 seconds ON

After the headlamps have been washed, they cannot be washed again for another 10 minutes (repeat lock).

The repeat lock is reset by Terminal R status OFF.

Safety Function

The signal from the reset contact on the wiper motor (also the rear window wiper on the E61) is used as an anti-jamming function for the wiper motor. If the signal from the resetting switch is not present when the wiper motor is switched on, the wiper motor is switched off again.

The wiper motor can then only be switched on one more time.

After that, the wiper motor can only be switched on subject to the following conditions:

- 3 minutes have elapsed
- Terminal R OFF followed by Terminal R ON

The wiper motor can only be switched on by operating the wiper switch (not automatically due to risk of injury).

Once the anti-jamming function has been activated, the windshield-washer and head-lamp-washer pumps can be operated 3 more times.

Replacing the Wiper System

Note: Operate the windshield-wiper switch before fitting the windshield-wiper arms.

Press the windshield-wiper switch once before fitting the windshield-wiper arms.

The wiper motor will then return to the parked position.

A replacement windshield-wiper system is supplied set to the change-over position. This enables fitting of the left-hand mounting bracket (2 screws).

Workshop Hints

Wiper Blades

The new-design wiper blades make removing/refitting easier and quicker.

When the wiper blades are replaced, the wiper-blade bearings are replaced as well. Worn wiper blade bearings do not therefore necessitate replacement of the windshield-wiper arms. The angle at which the wiper blade is set on the windshield-wiper arm is adjustable ($\pm 4^\circ$).

The wiper blades carry a model identification code (e.g. 5). The fixing geometry of the wiper-blade bearing prevents reversal of the left and right wiper blades.



Washer Jets

The washer jets are no longer adjustable (not ball-and-socket type). The E60 is fitted with fluidic washer jets. These jets wet the entire surface of the windshield (fan-shaped jet). It is neither possible nor necessary for the customer/service technician to adjust the jet.

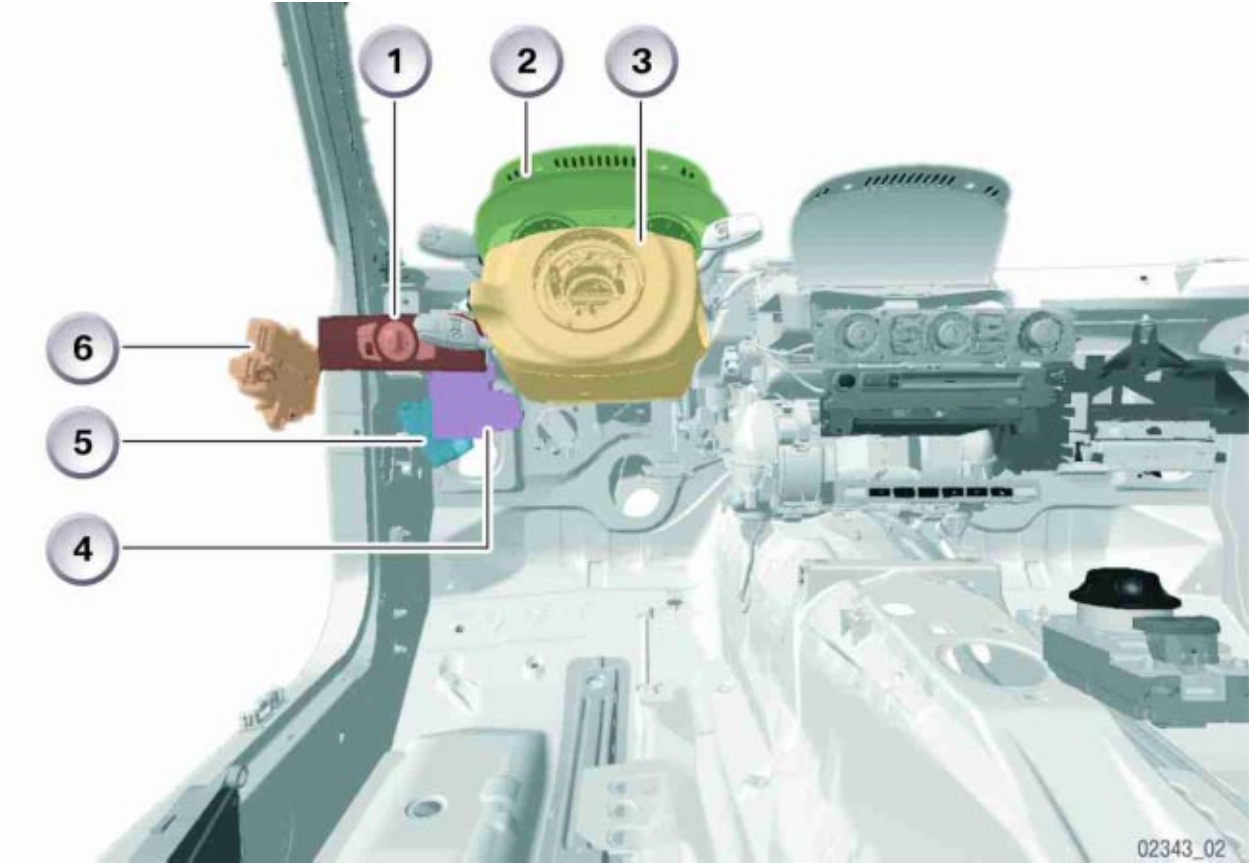


Car Access System

The CAS of the E60 is based on the CAS of the E65. The internal designation is CAS 2.

The following changes have been made compared with the CAS of the E65:

- Direct connection to the K-CAN
- Repeater function has been omitted
- Ignition starter switch and the CAS are 2 separate components
- Data transfer as part of the Condition Based Service



Index	Explanation	Index	Explanation
1	Light switch with control panel	4	CAS
2	Instrument Cluster	5	Light Module
3	SZL	6	TMFA

The CAS includes the following functions:

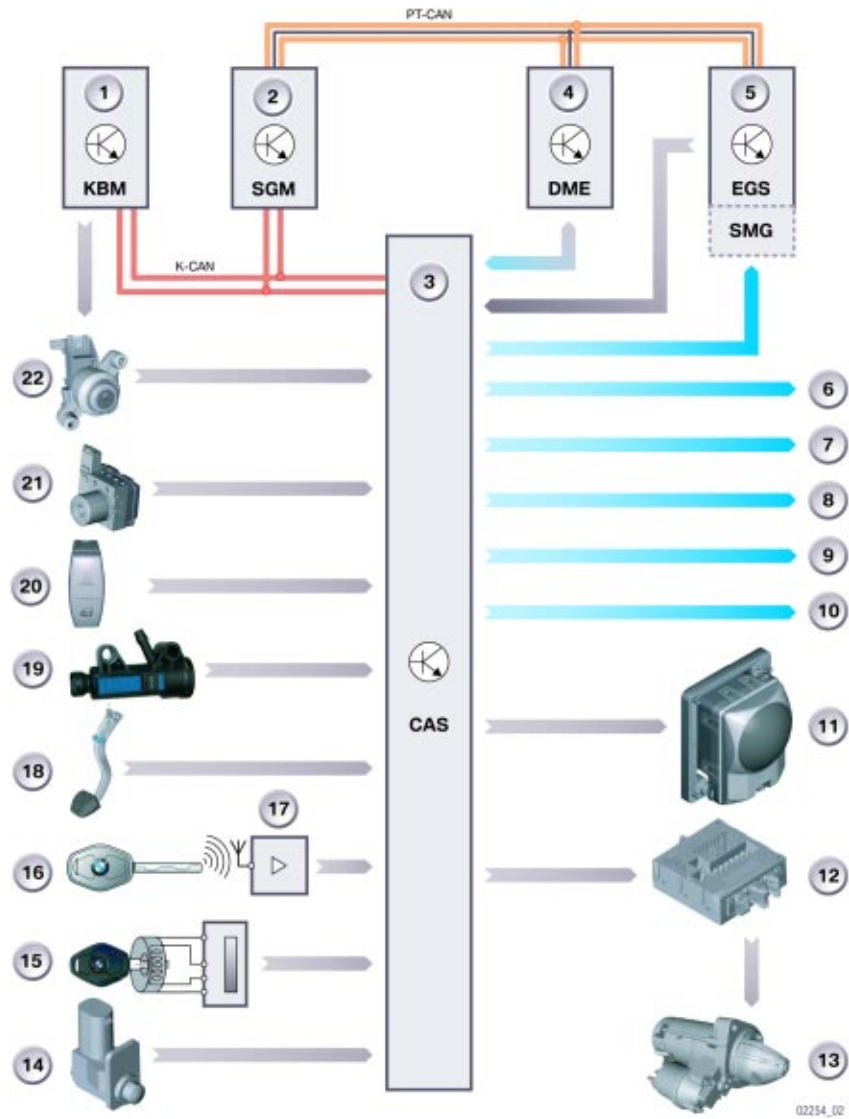
- Reading in ignition starter switch (ZAS)
- Transponder authentication
- Terminal control
- Electronic immobilizer enable to injection system
- Master function for central locking system (ZV)
- Master function for power windows (FH) and slide/tilt sunroof (SHD)
- Remote control services (FBD)
- Internal CAS functions
 - Wake-up signals
 - Sleep signals
- Vehicle functions
 - Personalization
 - Auto encoding of vehicle model/transmitter
 - Vehicle order
 - Total distance recorder
 - Condition Based Service CBS
 - Voltage supply, brake-light switch

Wake-up Time

The vehicle can be woken up by various control units. These control units have different wake-up times.

Control Unit	Wake-up time
CAS	750 milliseconds
SGM	500 milliseconds
IBS	550 milliseconds

CAS System Overview



Index	Explanation	Index	Explanation
1	KBM	12	Integrated Power Supply Module (IVM)
2	SGM	13	Starter
3	CAS	14	Hood Contact
4	DME (ECM)	15	Ignition/Starter Switch
5	EGS/SMG	16	Remote
6	Output EWS	17	Radio Receiver
7	Output Terminal R (KLR)	18	Brake Light Switch
8	Output Terminal 15 Wake-up	19	Clutch Switch Module
9	Output Terminal 15-1 to 15-3	20	Centerlock Button
10	Output Terminal 30g Relay	21	DSC
11	ACC wake-up line 15WUP_RS	22	Trunk Lock Cylinder

Workshop Hints

Condition Based Service

The data for Condition Based Service (CBS) is updated during each journey. The fault memory data is also updated during each journey. The conditions for this are:

- Activation of terminal 15, speed exceeded 50 km/h and speed dropped below 30km/h
- The data is updated after a distance of 10 km has been covered and after speed has dropped below 30 km/h

Manual Update of CBS Data

The procedure for transferring current data to the key during servicing is as follows:

- Insert key in ignition and turn to position "R"
- Press and hold Centerlock button
- After 15 s the CBS data will have been transferred to the key
- Read out the key

Manual Update of Fault Memory Data

- Press and hold Centerlock button
- Insert key in ignition
- Turn key from position "0" to position "R"
- After 15 s, the fault memory data will have been transferred to the key
- Read out the key



Workshop Exercise - CAS

Using an instructor designated vehicle, locate the CAS and prepare to connect the appropriate test cables.

Using the Oscilloscope, measure the EWS signal between the CAS and the DME (ECM).

Describe the signal shown and record scope settings below:

Using the appropriate fused jumper, ground the EWS signal. Remove ignition key for 20 seconds, then attempt to start vehicle.

What is observed regarding vehicle starting, fault codes etc?

Using the correct ETM, list the correct CAS pin numbers for the following:

SBE/OC-3 Power supply/Wakeup _____

SZL power supply/Wakeup _____

ACC Power supply/Wakeup _____

KL30g _____

Brake light switch input _____



Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the complaint outlined below. Complete worksheet using the "Complaint, Cause, Correction" format.

Vehicle: _____ Chassis #: _____ Production Date: _____

Complaint:

Cause:

Correction:



Classroom Exercise - Review Questions

1. What is different between the CAS module in the E65/66 and the CAS module in the 5 and 6 series?

2. Describe the communication path between the driver's door window switch and the passenger door power window motor:

3. Describe how the *byteflight* bus is involved in power window operation:

4. How is the LIN bus involved in the power window system?

5. Where are the door contact switches located and what is this input used for?



Classroom Exercise - Review Questions

6. Regarding sunroof operation, What is "Panic Mode" and How is it initiated?

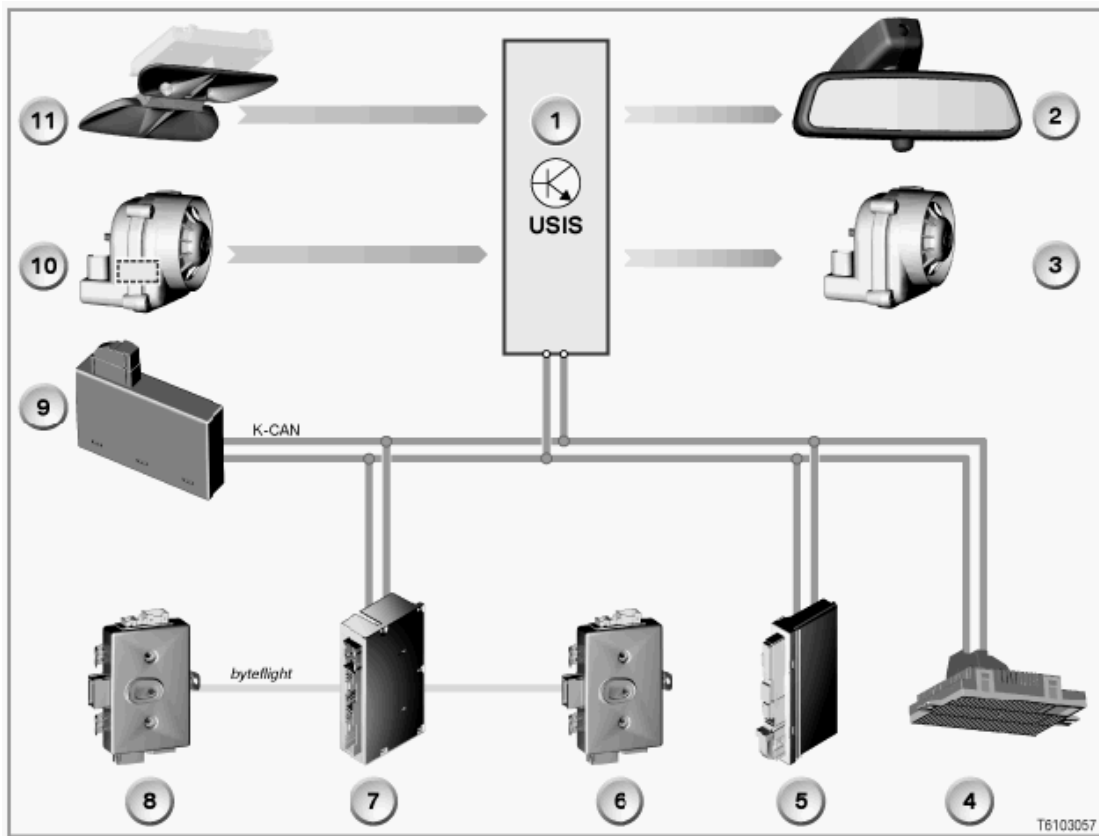
7. How does the E63 sunroof differ from the E60 sunroof?

8. Describe the signal path for the operation of the wipers?

9. What special tool is used to adjust the washer nozzles on the E60?

Anti-theft Alarm System

The anti-theft alarm system (DWA) detects and reports attempts at vehicle tampering or intrusion. The vehicle interior is monitored by the ultrasonic interior motion detector (USIS). If an attempt is made to break into the vehicle and to enter the interior, the DWA alarm is triggered. A tilt alarm sensor integrated into the siren monitors the vehicle's position. The tilt alarm sensor detects if the vehicle is raised or towed away. The DWA system uses an acoustic alarm via siren and visual indication via the exterior lights which are controlled through the Lamp Module (LM).



Index	Explanation	Index	Explanation
1	DWA control unit	7	Safety and Gateway Module (SGM)
2	DWA LED in rear view mirror housing	8	Passenger's door module (TMBF)
3	Siren (Acoustic Alarm)	9	Car Access System (CAS)
4	Light Module (for visual indication)	10	Tilt alarm sensor in siren housing (SINE)
5	Body Basic Module (KBM)	11	Ultrasonic interior motion sensor (USIS)
6	Driver's door module (TMFA)		

Components

The anti-theft alarm system receives input signals from the following components:

Ultrasonic Interior Motion Sensor

The ultrasonic interior motion sensor uses ultrasonic waves to monitor the vehicle interior. Movement is detected if the reflection (echo) of the ultrasonic waves changes. The sensitivity of the ultrasonic interior motion sensor can be adapted to different conditions (e.g. sliding/tilting sunroof open).

Tilt Alarm Sensor

The tilt alarm sensor monitors the vehicle's horizontal position (inclination in longitudinal and lateral directions). The signal from the tilt alarm sensor is evaluated by the microprocessor in the siren. The tilt alarm sensor detects a change in the vehicle position and triggers a DWA alarm.

Hood Contact Switch

The hood contact switch is a ground input to the CAS to indicate the status of the hood.

The following control units are involved in the anti-theft alarm system:

DWA Control Unit

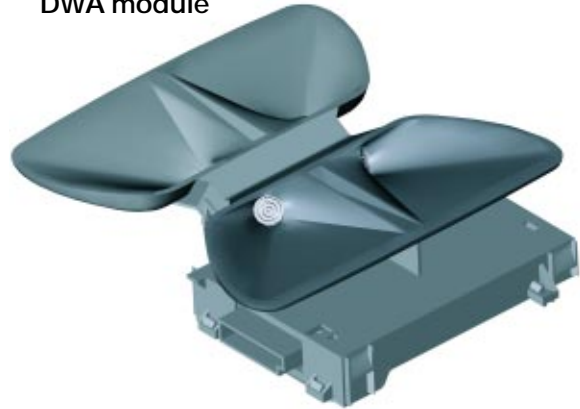
The DWA control unit is integrated into the housing for the ultrasonic interior motion sensor. The DWA control unit activates the siren via a single-wire bus. The DWA control unit is connected to the K-CAN.

Car Access System

The CAS control unit monitors the status of the central locking system. The hood contact switch is connected to the CAS control unit. The opening of the hood is thus monitored (open or closed). The CAS control unit feeds this signal to the DWA control unit via the K-CAN. The CAS control unit also supplies the following signals:

- Trunk-lid unlocking via remote control
- Key in ignition starter switch
- Status of convenience opening/closing

USIS with integrated DWA module



Driver's and Front-Passenger Door Modules

The door modules (TMFA and TMBF) supply information about the position of the front power windows. The signal is fed to the DWA control unit via the K-CAN.

In addition, the door modules monitor the door contacts in the front doors.

Body Basic Module (KBM)

The KBM supplies the position of the rear power windows. The signal is fed to the DWA control unit via the K-CAN.

The body basic module also monitors:

- Door contacts in rear doors
- Tailgate contact switch
- Rear window contact switch (E61 only)

Sliding/tilting Sunroof Control Unit

The SHD control unit supplies information about the position of the sliding/tilting sunroof (or Panorama glass sunroof on the E61). The signal is fed to the DWA control unit via the K-CAN.

Integrated Heating and Air Conditioning System

The integrated heating and air conditioning system (IHKA) controls the independent ventilation function. The IHKA feeds this signal to the DWA control unit via the K-CAN. The signal for the independent ventilation function is needed to calibrate the sensitivity of the ultrasonic interior motion sensor.

Light Module

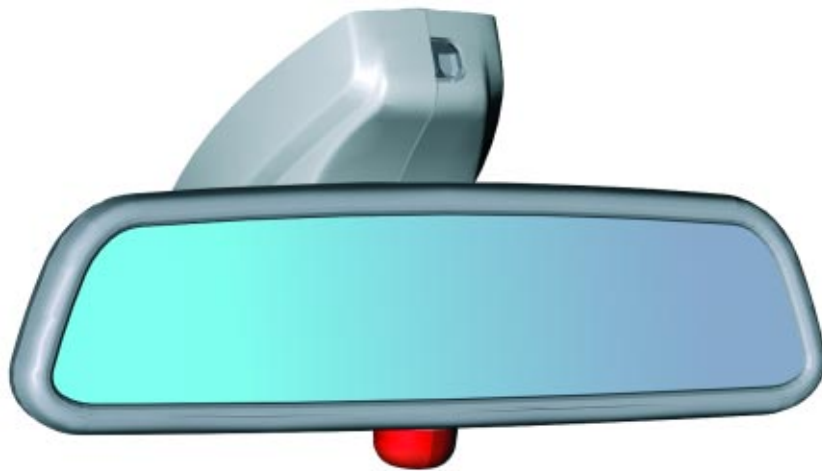
The light module (LM) actuates the lighting system for the visual DWA alarm. The DWA control unit feeds the triggering signal to the light module via the K-CAN.

The following actuators are actuated for the anti-theft alarm system:

Siren with Integrated Tilt Alarm Sensor

The siren with integrated tilt alarm sensor (SINE) emits the acoustic DWA alarm. The DWA control unit activates the siren via a single-wire bus. In addition to the DWA alarm, the siren can also emit an acoustic confirmation signal when the system is primed or disarmed (can be set on the Central Information Display and controller).

DWA LED



The DWA LED is located on the underside of the interior mirror and provides a visual indication of the status of the alarm system. The DWA LED is directly actuated by the DWA control unit via a wire. The following displays are possible:

- DWA LED off: DWA is disarmed.
- DWA LED flashes (frequency = 0.5 Hz): DWA is primed.
- DWA LED flashes with a frequency of 2 Hz for 10 seconds and then continues with a frequency of 0.5 Hz: DWA is primed but a door or hatch is not closed or a sensor is defective.
- DWA LED flashes with a frequency of 2 Hz for 5 minutes and then continues with a frequency of 0.5 Hz: alarm is triggered.
- DWA LED lights up for 2 seconds and then flashes with a frequency of 0.5 Hz: the ultrasonic interior motion sensor and the tilt alarm sensor are deactivated.

Principle of Operation

The anti-theft alarm system incorporates the following functions:

- Priming/disarming
- DWA alarm triggering (alarm-trigger signal)
- Automatic adaptation of sensitivity of ultrasonic interior motion sensor
- Deactivating interior motion sensor and tilt alarm sensor
- Emergency function for acoustic DWA alarm
- Combined operation with lock cylinder and remote control

Arming (priming)/disarming

The anti-theft alarm system is primed when the central locking is locked/deadlocked.

Locking/deadlocking requires:

The driver's door to be opened and closed after terminal 15 is switched OFF.

The DWA control unit transmits the "Prime" message to the siren with integrated tilt alarm sensor (SINE) via the local data bus. The siren is then immediately primed. 3 seconds after being primed, the door and hatch contacts are monitored. The condition for this is that the contacts have idle status (doors and tailgate / rear window on E61 closed).

The DWA LED starts flashing and the hazard warning lights flash once as a visual confirmation. Depending on the national version, a short acoustic warning tone may also sound from the siren (see national version).

After the DWA has been primed and all doors and hatches are closed (including the rear window on the E61):

- The ultrasonic interior motion sensor starts to map out the interior by means of ultrasonic waves. The interior can be monitored after approximately 20 seconds.
- The monitoring of the interior is interrupted if the side windows and/or the sliding/tilting sunroof are closed using the convenience closing function.
- Like the interior monitoring, the tilt monitoring does not start until the doors and hatches are closed. When it is activated, the tilt alarm sensor first conducts a 30 second long calibration sequence. Tilt monitoring does not start until the calibration sequence has been completed.
- If the luggage compartment is opened during the calibration sequence, the calibration sequence is interrupted. The calibration sequence is then restarted when the luggage compartment is closed again. The monitoring functions of the ultrasonic interior motion sensor and the tilt alarm sensor have priority. If a faulty door or hatch contact is detected, this will automatically be assumed to be closed.

-
- The anti-theft alarm system is disarmed when the central-locking system is unlocked. The DWA LED stops flashing and the hazard warning lights flash twice as a visual confirmation.
 - The luggage compartment can also be unlocked and opened with the remote control without the alarm being triggered, even if the alarm system is activated. When the luggage compartment is opened, the interior monitoring and tilt monitoring are deactivated. The interior monitoring and tilt monitoring are reactivated as soon as the luggage compartment is closed again.

DWA Alarm Triggering (Alarm-trigger Signal)

The DWA alarm is triggered if an alarm status is detected while the alarm system is activated. The following will trigger the DWA alarm:

- Forced opening of a door: Bus signal from door contact (via door modules or KBM).
- Forced opening of luggage compartment: Bus signal from tailgate contact switch via KBM.
- Forced opening of rear window on E61: Bus signal from rear window contact switch (via KBM)
- Forced opening of hood: Bus signal from hood contact switch (via CAS)
- Movement in interior: Signal from ultrasonic interior motion sensor
- Vehicle in inclined position: Signal from tilt alarm sensor
- Open circuit in local data bus (between DWA control unit and siren)
- Monitoring of vehicle battery:
 - On-board supply voltage drops from 7.5 to 6.5 volts within 40 minutes
 - Battery positive cable cut through
 - On-board supply voltage > 18 volts

When a DWA alarm is triggered, the DWA control unit activates the siren via the local data bus. At the same time, the DWA control unit transmits a message through the K-CAN. The light module activates the visual alarm via the lighting system.

The siren can trigger an acoustic alarm if it is separated from the vehicle electrical system by manipulation while the DWA is activated.

If the local data bus is separated as this happens, the DWA control unit will also trigger the visual alarm.

A DWA alarm will immediately be cancelled if:

- The DWA is disarmed (e.g. with the remote control)
- The message "key is in ignition lock" is detected (from CAS)

■ CAS Authentication to Prevent Tampering

To prevent the DWA from being easily disarmed by the central locking and tailgate status message "Central locking control" using a CAN tool, the CAS authenticates itself with the DWA.

Each time an unlocked vehicle is locked for the first time, the CAS sends an authentication to the DWA. Any further "locking" signals are then no longer accepted.

When the system is disarmed, the DWA expects the CAS to again send authentication with the first locking operation.

The system permits two disarming attempts with the wrong authentication, after which an alarm is issued.

■ Forced Disarming

The DWA is forcibly disarmed if a person located in the vehicle centrally locks the vehicle and then inserts the key into the ignition. The CAS evaluates this action and transmits a "locked" message. The DWA is thus disarmed.

■ Independent Voltage Supply

Due to the independent voltage supply, the emergency siren can issue an alarm even when the vehicle voltage supply is disconnected. The independent voltage supply is provided by Lithium (Li) cells. The Li cells are not rechargeable. The status of the batteries can be read out via the diagnostics system.

■ Reverse Polarity Detection

The reverse polarity detection system detects reverse polarity in the event of the vehicle being jump-started and stores this in its information memory.

System Power-Down for Storage

If the emergency siren is disarmed and without an external power supply, the batteries switch to a low power status. Current consumption is then a maximum of 25 A.

The electronics return the emergency siren to its normal operating status when the vehicle battery is reconnected.

■ Bus Monitoring

If the DWA detects messages on the local DWA bus that indicate attempts to disarm or tamper with the emergency siren or the tilt sensor, an alarm will be triggered.

Automatic adaptation of sensitivity of ultrasonic interior motion sensor

To prevent false alarms, the sensitivity of the ultrasonic interior motion sensor is adapted to the vehicle's conditions. To do this, the DWA control unit (and thus also the ultrasonic interior motion sensor) receives the following information via the K-CAN:

- Position of front power windows (door module, driver and front passenger)
- Position of rear power windows (body basic module)
- Position of sliding/tilting sunroof (sliding/tilting sunroof control unit)
- Status of comfort functions, e.g. convenience opening (Car Access System)
- Independent ventilation function (IHKA)

The range (sensitivity) of the ultrasonic signals is adapted. The positions of the side windows and the sliding/tilting sunroof are evaluated by the DWA. If no position value is available, a less sensitive setting is selected.

If the DWA is activated and a comfort function is executed (e.g. convenience closing using remote control):

- If the position of the side windows or sliding/tilting sunroof is changed, the interior monitoring function is deactivated for as long as the closing procedure runs.
- After the closing movement has been completed, or at most after 25 seconds the positions of the side windows and sliding/tilting sunroof are re-evaluated and the sensitivity adapted.

The switching-on of the independent ventilation is also monitored to prevent false alarms (movement in vehicle interior caused by airflow).

Deactivating interior motion sensor and tilt monitoring

It may be advisable to deactivate the tilt monitoring and interior motion sensor under the following conditions:

- When the vehicle is being transported (e.g. rail, ferry)
- When the vehicle is parked in a two-level garage
- When persons or animals remain in the vehicle

The tilt monitoring and interior motion sensor are deactivated when the command "lock/doublelock" is executed twice within the space of 10 seconds (e.g. with the remote control).

The DWA LED indicates the deactivation by lighting up for 2 seconds.

The ultrasonic interior motion sensor and the tilt alarm sensor can also be permanently deactivated (see Car and Key Memory).

Emergency Function for Acoustic DWA Alarm

If the siren fails during an alarm, or if the local data bus is interrupted, the acoustic alarm is emitted from the fanfare horn. To do this, the DWA control unit transmits a message to the steering column switch cluster (SZL).

Combined Operation with Lock Cylinder and Remote Control

The alarm system can be primed and disarmed by either the door lock or the remote control (= combined operation). In some countries, insurance requirements prohibit such combined operation.

In the event of the combined operation failing, the alarm system can still be primed at the door lock, but cannot be disarmed at the door lock. Disarming is only possible with the remote control. The function of the combined operation can be encoded in the CAS control unit.

DWA Alarm Output (coding)

Individual settings can be made with the Car & Key Memory

Acoustic confirmation from siren when primed and disarmed. The alarm tone can be set to an intermittent tone for 30 seconds

Panic Mode

Panic mode enables the DWA alarm to be triggered to attract attention in the event of a threat from the outside or an accident.

Panic mode is triggered with the remote control. To do this, the special button has to be pressed for 3 seconds. Panic mode can be triggered regardless of the DWA status (primed/disarmed). Panic mode is ended when any button on the remote control is pressed.

If the siren fails during panic mode, the acoustic alarm is emitted from the fanfare horn (emergency function).

The duration of the alarm in panic mode is unlimited (until the vehicle battery is flat).

E63/E64 Alarm System (DWA)

The alarm system detects and warns of any attempts to break in or tamper with the vehicle. The system is installed in various types of vehicles in different country-specific versions. The DWA of the E63 is equipped with multiplex microwave sensors, the CAN-Sine and the DWA LED.



New Features for DWA on E63 and E64 Vehicles

For the first time, not only the tilt alarm sensor, but also the software for the anti-theft alarm is integrated in the emergency power siren (SINE = siren and tilt alarm sensor). The DWA control unit used to date is no longer installed.

Also, new for BMW vehicles, the new multiplex microwave sensors (MuW) are fitted in the E63/E64.

The advantages of these MuW sensors are:

- Interior protection
- Effective MuW sensor detection during interior monitoring
- No false alarms triggered by MuW sensors during interior monitoring

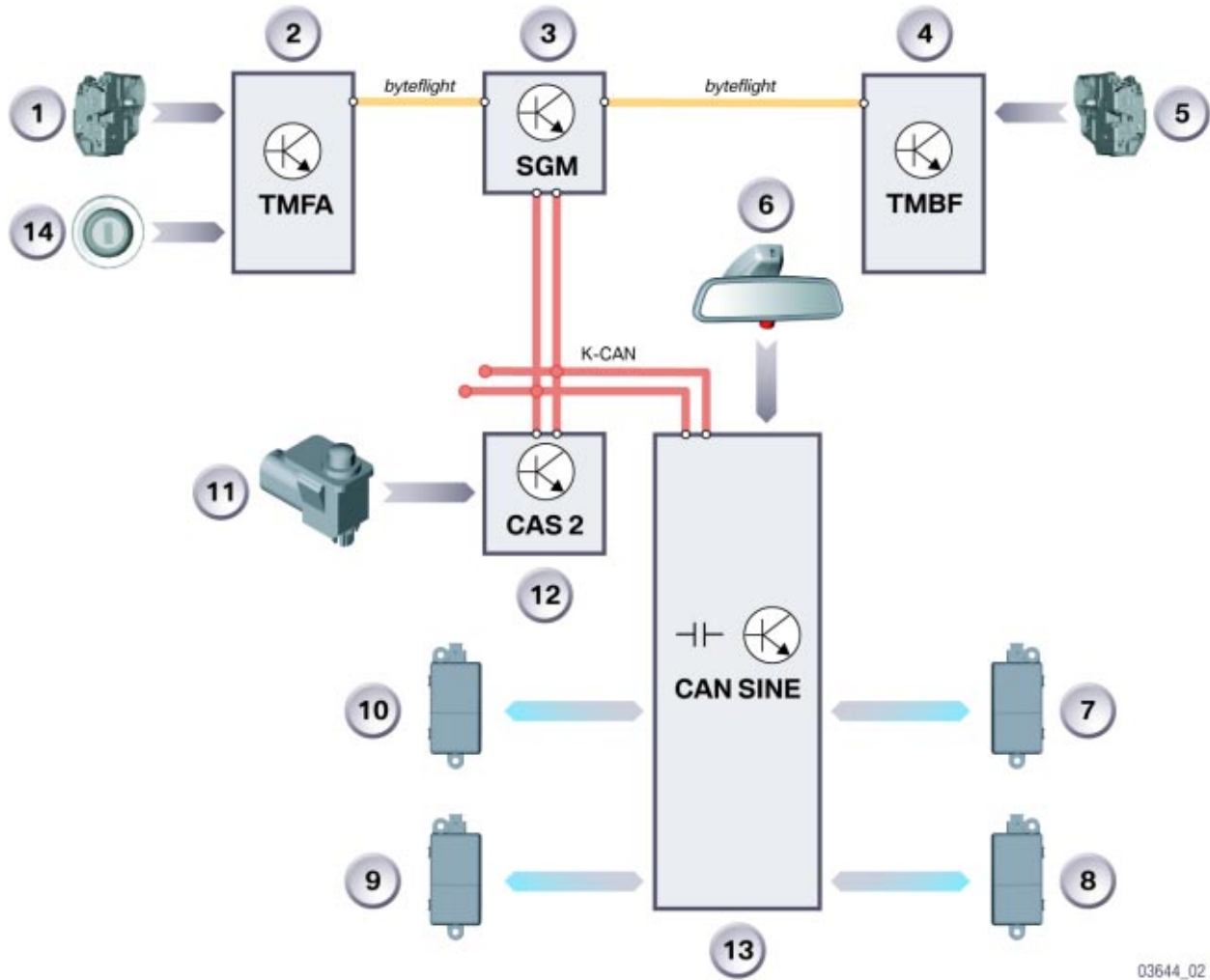
■ Advantages of Microwave Sensors

The microwave sensors can be installed in hidden locations.

The interior monitoring function works, for example, even when the side windows are open. The DWA control unit in the emergency power siren is connected to the microwave sensors by a sub-bus. When the boot-lid lock is mechanically unlocked with the key, the DWA alarm is triggered.

The anti-theft alarm system, integrated in the CAN-Sine, communicates with the components via the K-CAN or via the DWA bus.

DWA Overview (6 Series)



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Index	Explanation	Index	Explanation
1	Hall Sensor, driver's door	8	Multiplex microwave sensor, rear passenger side
2	Driver's door module (TMFA)	9	Multiplex microwave sensor, Rear driver's side
3	Safety and Gateway Module (SGM)	10	Multiplex microwave sensor, drivers side door
4	Passenger door module (TMBF)	11	Hood contact
5	Hall sensor, passenger's door	12	CAN-SINE tilt alarm sensor with integrated emergency current siren
6	DWA LED	13	Car Access System (CAS 2)
7	Multiplex microwave sensor, passenger door)	14	Lock, driver's door

Components

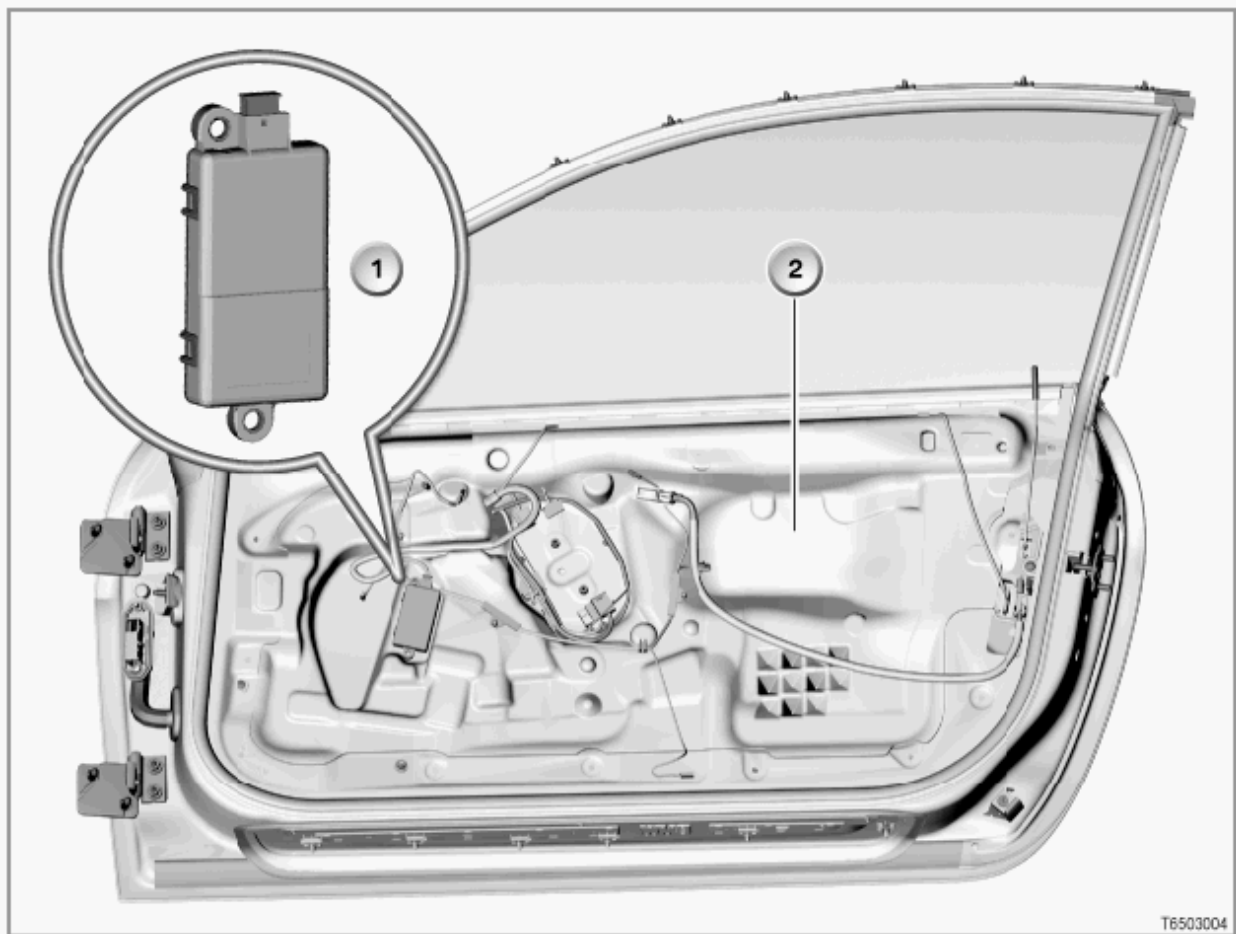
The following component description concerns changes to the DWA components on the 6 series (E63/E64). Unless otherwise mentioned, the components are the same as the 5 series (E60/E61).

The anti-theft alarm system receives input signals from the following components:

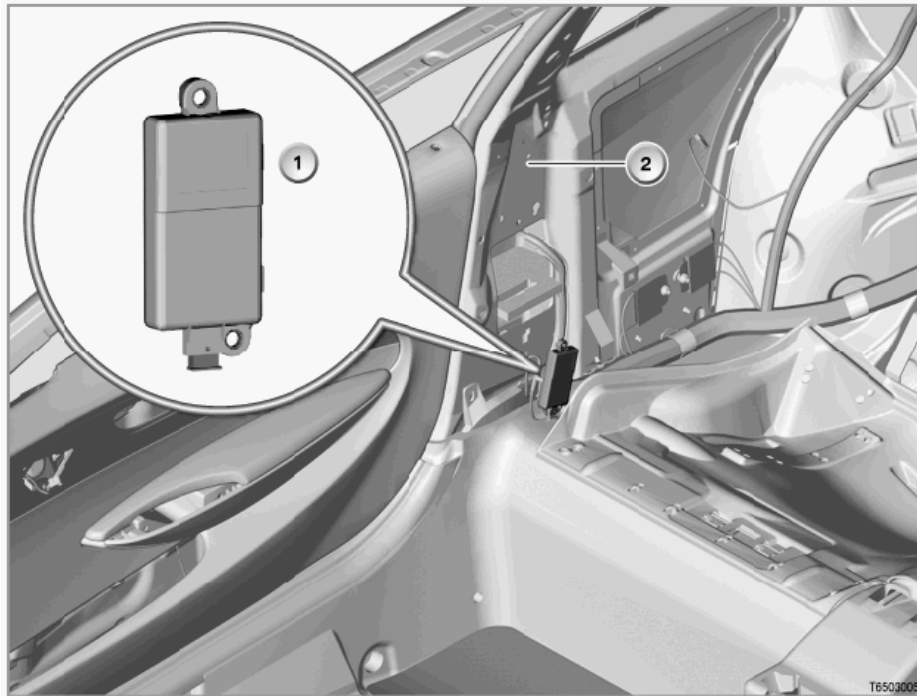
■ Microwave Sensors

The microwave sensors monitor the vehicle interior. Movement is detected if the reflection (echo) of the microwaves changes. The sensitivity of the microwave sensors is adapted for different conditions (e.g. vehicle model, installation location of microwave sensors).

Two of the microwave sensors are installed on the inner door panel of the driver's door and front-passenger door. The other two additional microwave sensors are installed on the inside of the B-pillars.



Index	Explanation	Index	Explanation
1	Microwave Sensor	2	Inner door panel



Index	Explanation	Index	Explanation
1	Microwave Sensor	2	B-pillar

Construction

Each microwave sensor consists of the following components:

- Transmitter unit
- Receiver unit
- Interface to sub-bus for anti-theft alarm
- Internal circuit for 5-volt power supply



■ Car Access System (CAS)

The CAS monitors the central locking system.

The bonnet contact switch is connected to the CAS. The bonnet is thus monitored (open or closed). The CAS feeds the signal to the DWA control unit in the emergency power siren via the K-CAN. The CAS supplies the following signals:

- Boot-lid unlocking via remote control
- Key in ignition starter switch or terminal 15 ON
- Status of convenience opening/closing
- Authentication by CAS as protection against manipulation (refer to E60/E61)

■ Driver's Door Module (TMFA) and Front-passenger Door Module (TMBF)

The door modules provide information about the position of the door contacts. The signal is fed to the DWA control unit in the emergency power siren via the K-CAN. The driver's door module also provides the signal from the lock cylinder.

■ Body Basic Module (KBM)

The body basic module monitors the boot lid (open or closed). The signal is fed to the DWA control unit in the emergency power siren via the K-CAN.

When the boot-lid lock is mechanically unlocked with the key, the DWA alarm is triggered.

■ Light Module (LM)

The light module actuates the lighting system for the visual DWA alarm. The DWA control unit feeds the triggering signal to the light module via the K-CAN.

The following actuators are actuated for the anti-theft alarm system:

■ Emergency power siren with integrated tilt alarm sensor (SINE)

The emergency power siren emits the acoustic DWA alarm. In addition to the DWA alarm, the emergency power siren can also emit an acoustic confirmation signal when the system is activated or deactivated (can be set on the Central Information Display (CID) and controller).

■ DWA LED

The DWA LED is on the bottom of the inside rearview mirror. The LED gives a visual indication of the status of the anti-theft alarm. It is directly actuated by the DWA control unit in the emergency power siren via a wire.

For the operation of the DWA LED, refer to the E60 DWA section.

Principle of Operation

The anti-theft alarm system incorporates the following functions:

- Activating and deactivating
- DWA alarm triggering (alarm-trigger signal)
- Undervoltage recognition, overvoltage recognition, car battery monitoring (positive and negative cables)
- Monitoring of sub-bus
- Deactivating interior motion sensor and tilt monitoring
- Emergency function for acoustic DWA alarm
- Combined operation with lock cylinder and remote control

■ Activating and Deactivating

The anti-theft alarm system is activated when the central locking is locked/secured.

Locking/securing requires:

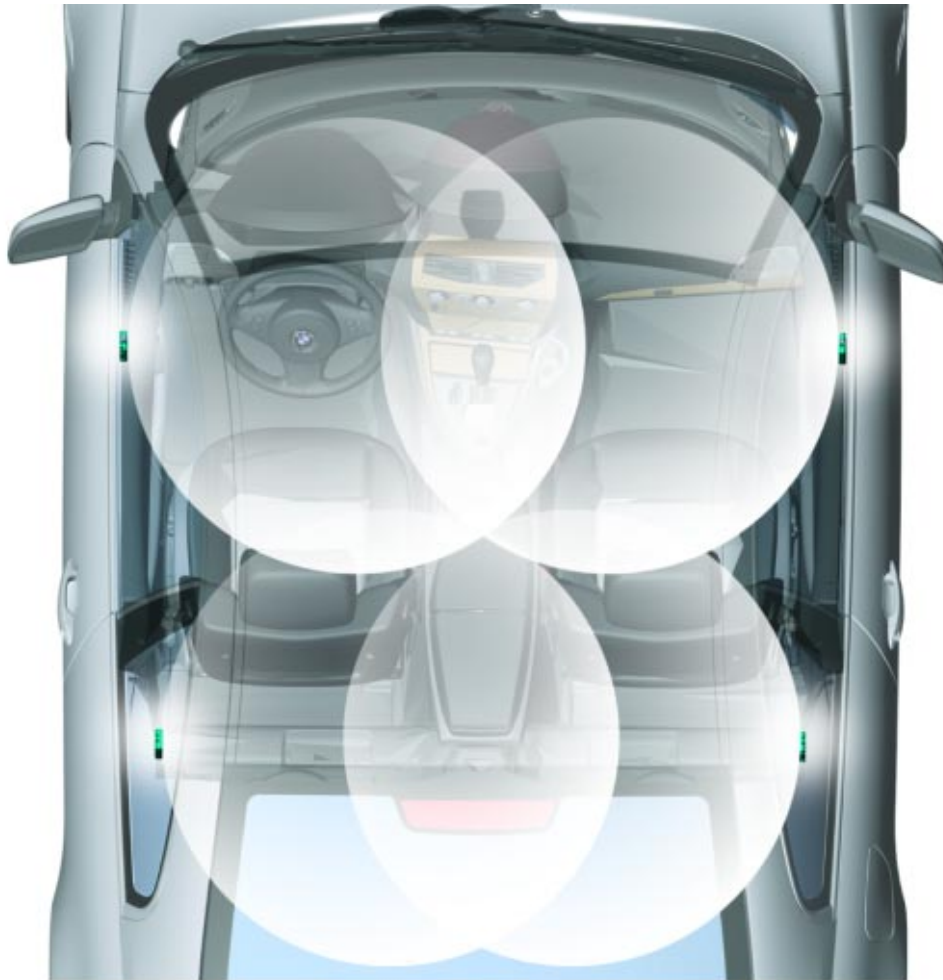
- Drivers door to be opened and closed after terminal 15 is switched OFF.
- The emergency power siren is then immediately activated.
- 3 seconds after activation, the door and hatch contacts are monitored. This is conditional on the contacts being in their rest position (doors and hatches closed).
- The DWA LED starts to flash as a visual acknowledgement. The hazard warning lights flash once.
- Depending on the national version, a short acoustic warning tone may also sound from the emergency power siren (see national version).

■ Sensor Operation

The microwave sensor is a movement detector. The microwave sensor detects movement and the direction of movement (changes in distance) in the entire vehicle interior. The range/sensitivity of the microwave sensors is pre-set (depending on vehicle model and equipment).

3 seconds after the last door or hatch is closed, the microwave sensor starts its reference run.

During the reference run, the vehicle interior is "scanned". This allows any changes in the vehicle interior (e.g. objects left on the rear seat) to be recognized. A self-test monitors the correct functioning of the microwave sensors. The microwave sensors are operational 20 seconds after the start of the reference run.



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The 4 microwave sensors monitor the vehicle interior in zones. For this, the vehicle interior is divided into 4 quadrants.

The microwaves disperse in the shape of a sphere.

The DWA control unit actuates the microwave sensors in the following order:

The microwave sensors work in a frequency range of approximately 2.5 GHz. The microwave sensor uses the Doppler effect to create the alarm trigger signal.

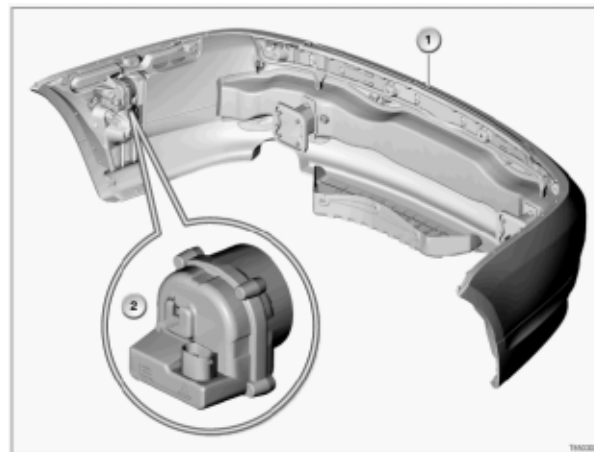
The DWA control unit in the emergency power siren evaluates the signals from the microwave sensor and triggers the alarm.

The emergency power siren for the acoustic alarm is actuated. The signal for the visual alarm is fed to the light module through the K-CAN.

■ Tilt Alarm Sensor

The tilt alarm sensor monitors the vehicle's horizontal position (inclination in longitudinal and lateral directions).

The signal from the tilt alarm sensor is evaluated by the DWA control unit. The tilt alarm sensor detects when the vehicle is raised or towed away and triggers a DWA alarm.



1. Rear Bumper
2. Siren with integrated DWA functions and tilt sensor

The following control units are involved in the anti-theft alarm system:

■ DWA Control Unit

The software for the DWA is integrated in the emergency power siren. The DWA control unit in the emergency power siren controls the anti-theft alarm.

The microwave sensors are connected to the alarm system control unit by a single-wire bus (K-Bus). The DWA control unit is connected to the K-CAN.

- After the DWA has been activated, and after all doors and flaps have been closed, the microwave sensors start to monitor the interior. The interior can be monitored after approximately 20 seconds.
- The monitoring of the interior is interrupted if the side windows and/or the sliding/tilting sunroof are closed using the convenience closing function.

Like the interior monitoring, the tilt monitoring does not start until the doors and hatches are closed. When it is activated, the tilt alarm sensor first conducts a 30 second long reference run. Tilt monitoring does not start until the reference run has been completed.

If the luggage compartment is opened during the reference run, the reference run is interrupted. The reference run is then restarted when the luggage compartment is closed again. The monitoring function of the microwave sensors and the tilt alarm sensor have priority. If a faulty door or hatch contact is detected, this will automatically be assumed to be closed.

The anti-theft alarm system is deactivated when the central-locking system is unlocked. The DWA LED stops flashing and the hazard warning lights flash twice as a visual confirmation. Depending on the national version, a short acoustic warning tone (dual tone) may also sound from the emergency power siren (see national version).

The boot lid can also be unlocked and opened with the remote control without the alarm being triggered, even if the alarm system is activated. When the boot lid is opened, the interior and tilt monitoring functions are deactivated. The interior monitoring and tilt monitoring are reactivated as soon as the boot lid is closed again.

■ DWA Alarm Triggering (Alarm-trigger Signal)

The DWA alarm is triggered if an alarm status is detected while the alarm system is activated. The following will trigger the DWA alarm:

- Forced opening of a door: Bus signal from door module (door contact)
- Forced opening of trunk lid: Bus signal from KBM (trunk lid contact switch)
- Forced opening of hood: Bus signal from CAS (hood contact switch)
- Movement in interior: signal from microwave sensors
- Vehicle in inclined position: signal from tilt alarm sensor
- Open circuit in sub-bus (between the alarm system control unit in the emergency power siren and the microwave sensors)
- Undervoltage, overvoltage, car battery monitoring (positive and negative cables)

When a DWA alarm is triggered, the DWA control unit activates the emergency power siren loudspeaker. At the same time, the DWA control unit transmits an alarm signal through the K-CAN. The light module activates the visual alarm via the lighting system.

The emergency power siren may also trigger an acoustic alarm if the anti-theft alarm is active and the emergency power siren is separated from the vehicle electrical system by manipulation (integral power supply from batteries).

The DWA alarm is interrupted immediately under the following conditions:

- Anti-theft alarm is deactivated
- Message "Key in ignition lock" (from CAS) and terminal 15 ON

■ Undervoltage recognition, overvoltage recognition, car battery monitoring

When the anti-theft alarm is active, the DWA control unit monitors the on-board supply voltage in the range between 6.5 and 17 volts.

The DWA control unit recognizes the following deviations:

- Undervoltage On-board supply voltage less than 6.5 volts
- Overvoltage On-board supply voltage greater than 17 volts
- On-board supply voltage drops from 7.5 to 6.5 volts within 40 minutes
- Battery positive or negative cable cut through

The voltage thresholds for overvoltage and undervoltage must be recognized for at least 250 milliseconds.

■ Monitoring of sub-bus for anti-theft alarm

The sub-bus between the alarm system control unit in the emergency power siren and the microwave sensors is monitored for open circuits.

■ Deactivating interior motion sensor and tilt monitoring

It may be advisable to deactivate the tilt monitoring and interior motion sensor under the following conditions:

- When the vehicle is being transported (e.g. rail, ferry)
- When the vehicle is parked in a two-level garage
- When persons or animals remain in the vehicle

The tilt monitoring and interior motion sensor are deactivated when the command "lock/secure" is executed twice within the space of 3 seconds (e.g. with the remote control).

The DWA LED indicates the deactivation by lighting up for 2 seconds.

The microwave sensors and the tilt alarm sensor can also be permanently deactivated (see Car and Key Memory). Emergency function for acoustic DWA alarm

If the emergency power siren fails during an alarm, or if the sub-bus to the microwave sensors is interrupted, the acoustic alarm will be emitted through the fanfare horn. To do this, the DWA control unit transmits a message to the steering column switch cluster (SZL).

■ Combined operation with lock cylinder and remote control

The alarm system can be activated and deactivated by either the door lock or the remote control (= combined operation). In some countries, insurance requirements prohibit such combined operation.

In the event of the combined operation failing, the alarm system can still be activated at the door lock, but cannot be deactivated at the door lock. Deactivation is only possible with the remote control. The combined operation function can be encoded in the Car Access System (CAS).

■ Operation

The visual and acoustic confirmation for activation and deactivation is not a function of the Car and Key Memory.

The customer is able to set the type of confirmation using the Central Information Display and the controller (menu "Settings" under "Vehicle settings").

■ Panic Mode

Panic mode enables attention to be attracted in the event of a threat from the outside or an accident (DWA alarm). Panic mode must be encoded.

The button for trunk lid unlocking then works as a button for panic mode.

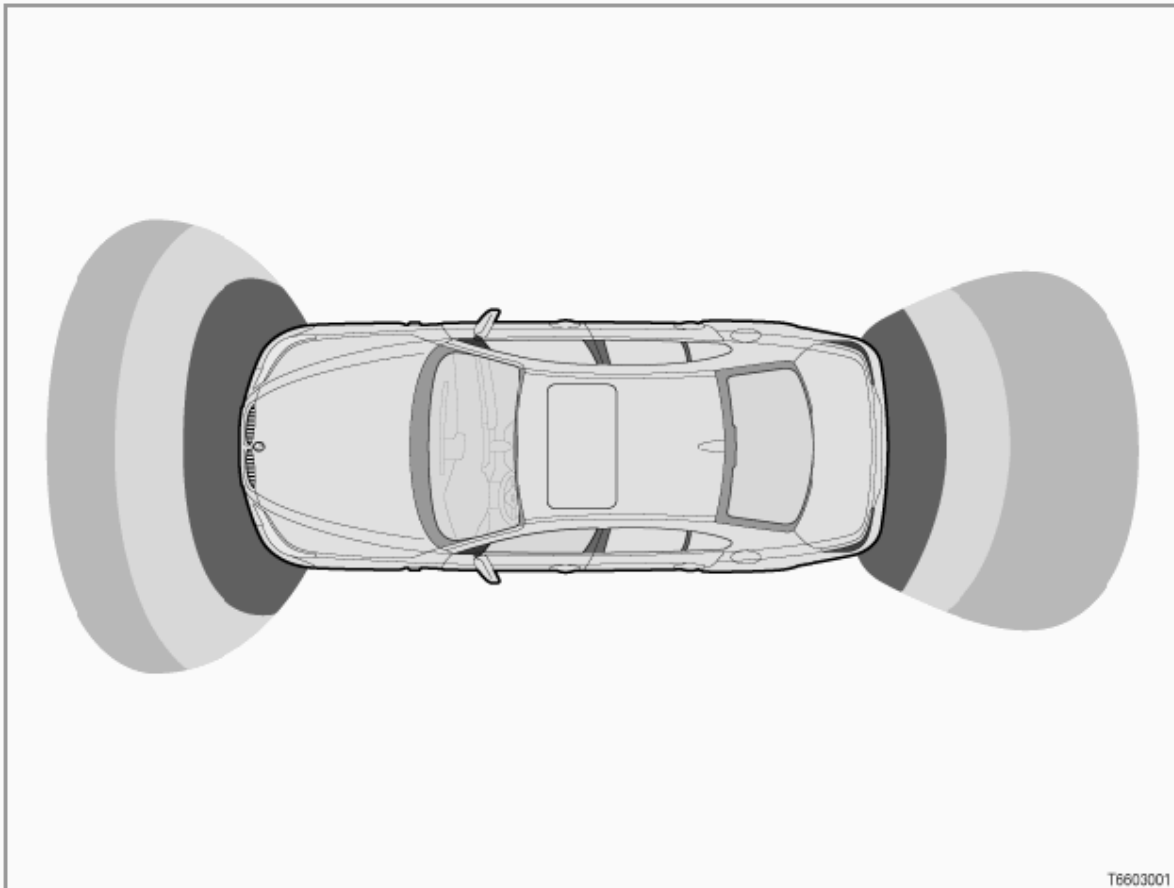
The button has to be pressed for 3 seconds.

Panic mode can be triggered regardless of DWA status (activated/deactivated). Panic mode is ended when any button on the remote control is pressed. If the emergency power siren fails during panic mode, the acoustic alarm is emitted from the fanfare horn (emergency function).

The duration of the alarm in panic mode is unlimited (until the vehicle battery is flat).

Park Distance Control PDC

The E60 is equipped with the 8-channel PDC system which is carried over from the E65. On the 5 and 6 series, PDC is optional equipment. The system supports the driver in maneuvering in tight parking scenarios.



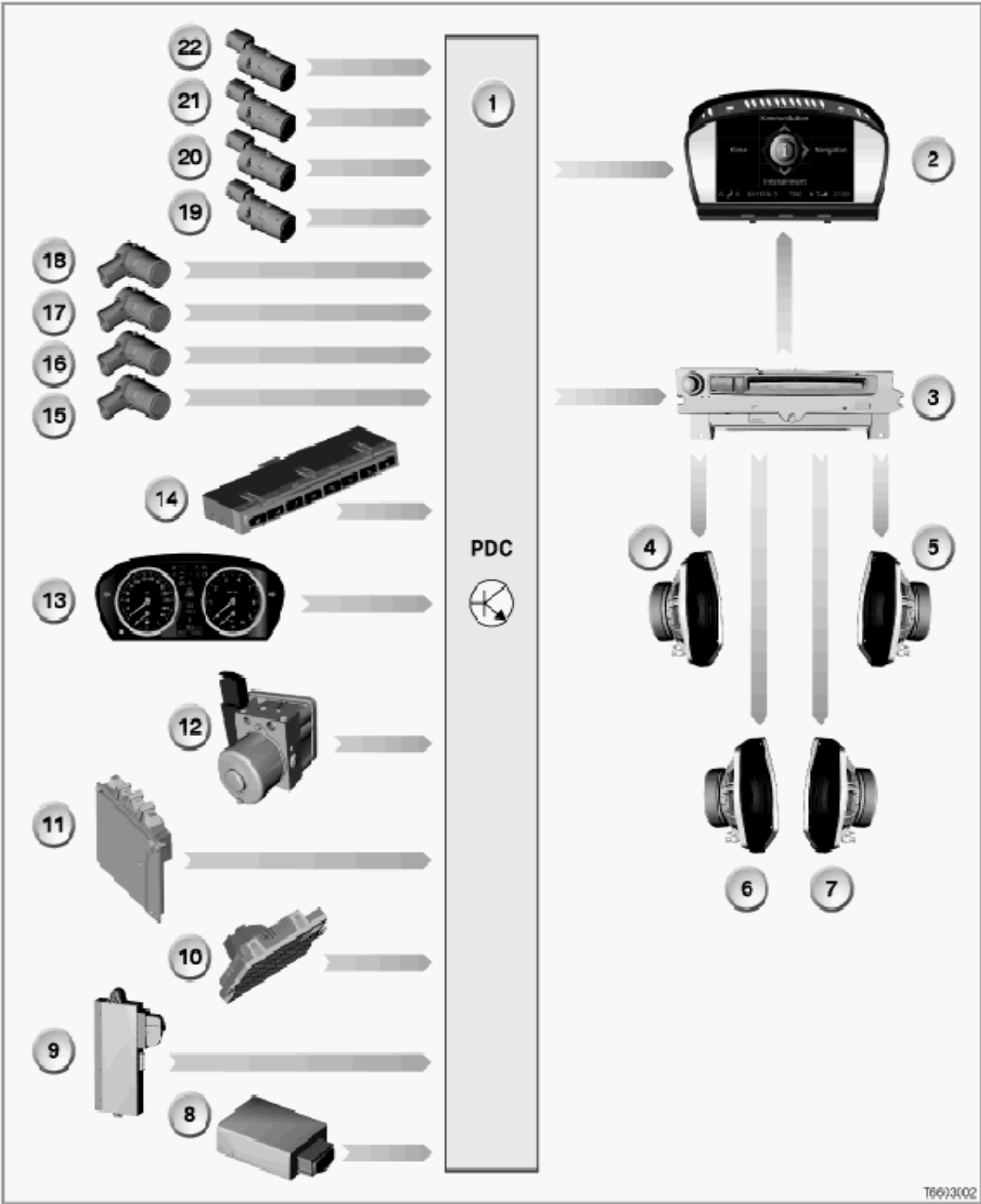
On the E60, PDC has the following new features:

- The PDC button is in the SZM. The signal from the PDC button is transferred to the PDC control unit through the K-CAN.
- The signal from the reverse-light switch (reverse gear engaged) on vehicles with manual transmission is transferred from the light module to the PDC control unit via the K-CAN.
- Display form of the optical warnings on the Central Information Display.

For an automatic gearbox, the signal for reverse gear is made available by the EGS control unit by way of a K-CAN message.

The PDC measures the distance to objects within its range with ultrasonic sensors. These sensors are carrier over from the E65.

E60 PDC System Overview



Legend for System Overview

Index	Explanation	Index	Explanation
1	PDC Module	9	Car Access System (CAS)
2	Central Information Display (CID)	10	Light Module (LM)
3	M-ASK or CCC	11	Electronic Transmission Control (EGS)
4	Mid-Range loudspeaker (driver's door)	12	Dynamic Stability Control (DSC)
5	Mid-Range loudspeaker (passenger door)	13	Instrument Cluster
6	Mid-Range loudspeaker (left rear)	14	Center Console Switch Center (SZM)
7	Mid-Range loudspeaker (right rear)	15-18	Ultrasonic Sensors (rear)
8	Trailer Module (AHM) Not for US	19-22	Ultrasonic Sensors (front)

The driver is warned of an object that could cause a collision as follows:

- Acoustic warning (via M-ASK (or CCC), and mid-range loudspeaker)
- Visual warning (via Central Information Display)

The PDC uses these two 2 warning functions to offer a degree of comfort for drivers who are hard of hearing or physically impaired.

A fault in the PDC is indicated by a Check-Control message.

Important: Responsibility remains with the driver at all times

PDC is unable to take the place of the driver's personal assessment of obstacles.

The ultrasonic sensors have a blind spot. Objects in this blind spot cannot be detected. The ability to detect objects can stretch the physical limits of ultrasonic measurements (no or poor reflection of ultrasonic impulses, e.g. trailer tow bars or narrow objects).

Low objects that have already been indicated can "disappear", before a continuous tone sounds (e.g. a high curb).

The evaluation of obstacles is thus the responsibility of the driver, even with PDC.

Components

PDC consists of the following components:

Ultrasonic Sensors

There are 4 ultrasonic sensors in each of the front and rear bumpers. The sensors emit ultrasonic impulses. These ultrasonic impulses are reflected by obstacles (echo impulses).

The ultrasonic sensors receive and amplify these echo impulses. The amplified echo impulses are then converted into a digital signal. Each ultrasonic sensor has its own microprocessor, its own power supply and its own data connection to the PDC control unit.

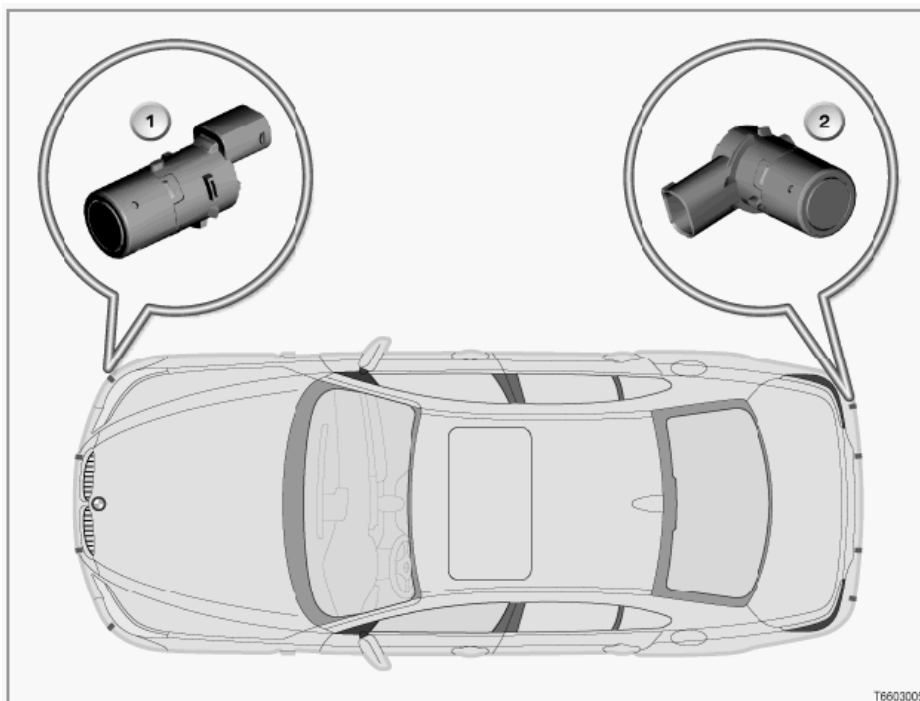
Important: Measuring range of ultrasonic sensors

The measuring range of the ultrasonic sensors is between approximately 25 centimeters and 200 centimeters. If the minimum distance that can be detected rises to an impermissible level, a fault message is entered in the fault memory.

Dirt contamination, moisture, ice and snow can cause an impermissible rise in the minimum distance that can be detected.

Note: Cleaning the ultrasonic sensors

To make sure the system remains fully operational, keep the ultrasonic sensors clean and free from ice. Do not clean by spraying high-pressure washers directly at the ultrasonic sensors. When cleaning, always maintain a minimum distance of at least 10 centimeters.



PDC Button

The PDC button is in the center console switch cluster (SZL). The signal from the PDC button is transferred through the K-CAN to the PDC control unit.

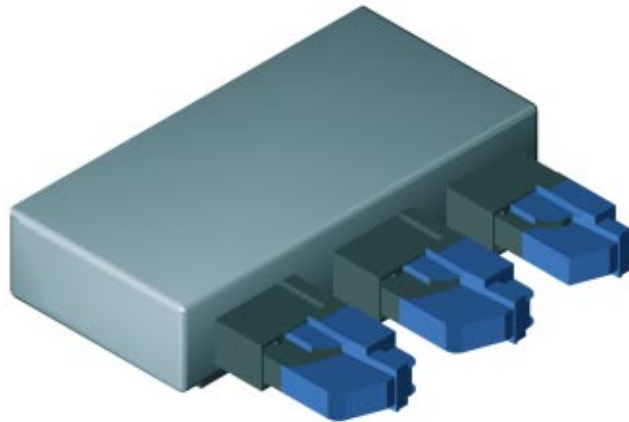


The PDC button is used to manually switch the Park Distance Control system on and off. When the PDC is switched on, the function LED in the PDC button lights up.

If a fault develops in the PDC, the function LED in the PDC button flashes.

PDC Control Unit

The PDC control unit controls the ultrasonic sensors for transmitting ultrasonic impulses. The PDC control unit also receives the digital signals from the individual ultrasonic sensors. By comparing the individual digital signals, the PDC control unit calculates the minimum distance between the ultrasonic sensor and the object.



When an object is detected, an acoustic warning and a visual warning are given.

The PDC control unit is connected to the following control units via the bus systems:

Multi-audio System Controller / Car Communication Computer

The multi-audio system controller (M-ASK) or Car Communication Computer (CCC) emits the PDC acoustic warning through the mid-range loudspeakers.

Central Information Display

The visual PDC warnings are given in the Central Information Display (CID).

In addition, information regarding a Check-Control message that may be present is shown.

Instrument Cluster

A current Check-Control message is indicated by a symbol in the LCD display in the instrument cluster. Moreover, the instrument cluster also provides the exterior temperature and the mileage reading for the PDC control unit.

Ice and frost can cause an unexpected response from the ultrasonic sensors. The response characteristics of the ultrasonic sensors changes depending on the exterior temperature.

If a fault is stored in the fault memory, the kilometer reading and the exterior temperature are also stored.

DSC Control Unit

The DSC control unit supplies the PDC with information about the roadspeed and distance travelled.

Electronic Transmission Control

On vehicles with automatic transmission, the electronic transmission control (EGS) supplies the signal that reverse gear is engaged.

Light Module

On vehicles with manual transmission, the light module (LM) supplies the signal that reverse gear is engaged.

Car Access System

The CAS control unit supplies the PDC with the terminal status (e.g.. terminal 15).

For vehicles from 03/2004, power is supplied to the PDC control unit through terminal 30g (active) instead of terminal 15.

Principle of Operation

PDC incorporates the following functions:

- Acoustic warnings
- Visual warnings
- Check Control

Acoustic Warnings

The acoustic warnings are emitted by the M-ASK via the mid-range loudspeaker.

If an object is detected by 2 ultrasonic sensors, the loudspeaker closest to the object is actuated. The mid-range loudspeaker in the left/right-hand front doors or the mid-range loudspeaker on the left/right-hand sides of the rear shelf can be actuated. If an object is detected by 3 ultrasonic sensors, the mid-range loudspeakers on the left and right-hand sides are actuated together.

The smaller the distance to the object, the faster the sequence of acoustic warning tones. A distance of less than approximately 25 centimeters is indicated by a continuous tone. The warning tone switches off as soon as the vehicle moves away from the object.

If the vehicle is moving directly towards a wall, the acoustic warning tone will be switched off after approximately 3 seconds so that it does not distract the driver. If the vehicle continues to approach the wall, the warning will be reactivated.

Effective range for acoustic warnings:

- Approximately 60 centimeters for the ultrasonic sensors at the two corners of the front bumper
- Approximately 70 centimeters for the two middle ultrasonic sensors in the front bumper
- Approximately 60 centimeters for the ultrasonic sensors at the two corners of the rear bumper
- Approximately 150 centimeters for the two middle ultrasonic sensors in the rear bumper

Visual Warnings

The visual PDC warnings are given in the Central Information Display (CID). This is subject to the display in the CID being active. The visual warnings are given earlier than the acoustic warnings.

The effective range is approximately 2 meters at the front and approximately 2.5 meters at the rear.

The graphic display is shown on the CID. The PDC control unit supplies the distance between the ultrasonic sensor and the object detected via the K-CAN. The display on the CID is an overhead view of the vehicle with the effective ranges of the ultrasonic sensors.

The distance to objects detected is shown in the colors of traffic lights:

- Distance down to 100 centimeters: green
- Distance between 100 and 50 centimeters: yellow
- Distance less than 50 centimeters: red

The display appears as soon as the PDC is switched on (manually or automatically). The display overrides other displays in the CID. When the PDC is switched off again, the previous display automatically appears again in the Central Information Display.

Check Control

If a fault develops in the PDC, the function LED in the PDC button flashes. If this occurs, PDC cannot be switched on.

At the same time, a Check-Control message is displayed in the following form:

- Symbol in the LCD display in the instrument cluster
- The following text appears in the status line of the Central Information Display:
"PDC failure!"

In the menu "BMW Service", the following text can be called up in the submenu "Check-Control messages": "Park Distance Control"

No acoustic warning available for Park Distance Control (PDC). Have the problem checked by BMW Service as soon as possible.

Conditions for Switching On and Off

PDC is switched on under the following conditions:

- PDC button pressed (PDC switched on manually)
- Reverse gear engaged (PDC switched on automatically)

PDC is switched off under the following conditions:

- PDC button pressed (PDC switched off manually)
- Ignition switched off (PDC switched off automatically)
- After driving approximately 50 meters
- After exceeding a speed of 30 km/h

■ Problematic Conditions for Switching On and Off

In borderline situations, PDC may give a warning even though there is no object within the effective range (reflection from the ground, e.g. on coarse gravel).

In borderline situations, it could happen that objects that are present are not detected (no or insufficient reflection due to geometric form).

Under the following conditions, it could happen that the PDC gives a warning, even though there is no object within the effective range:

- Ultrasonic sensor incorrectly located in its bracket
- Heavy rain
- Severe dirt contamination or icing of the ultrasonic sensors
- Ultrasonic sensors covered in snow
- Echo pulses caused by ground, e.g. extremely coarse road surface or high grass
- Very smooth walls in large, enclosed, rectangular spaces, e.g. in underground car parks (interference from earlier, reflected echo impulses)

Under the following conditions, the PDC may not recognize an obstacle that is present:

- Low objects or objects with corners and sharp edges (no reflection)
- If you drive alongside a wall while you are parking, the acoustic warning will be deactivated so long as you are moving parallel to the wall.

Operation

The visual warning (display) is switched on in the Central Information Display (CID) as follows:

- "Settings" menu
- "Vehicle settings" menu
- "PDC" menu
- Activate "Display on"

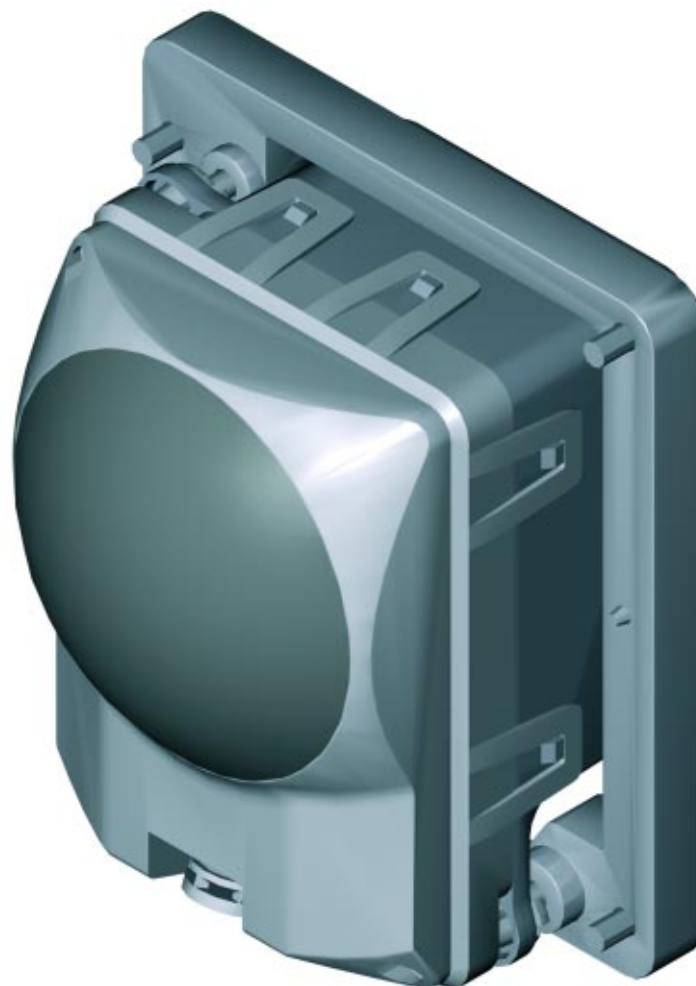
Active Cruise Control

The Active Cruise Control system (ACC) is the same as that in the E65.

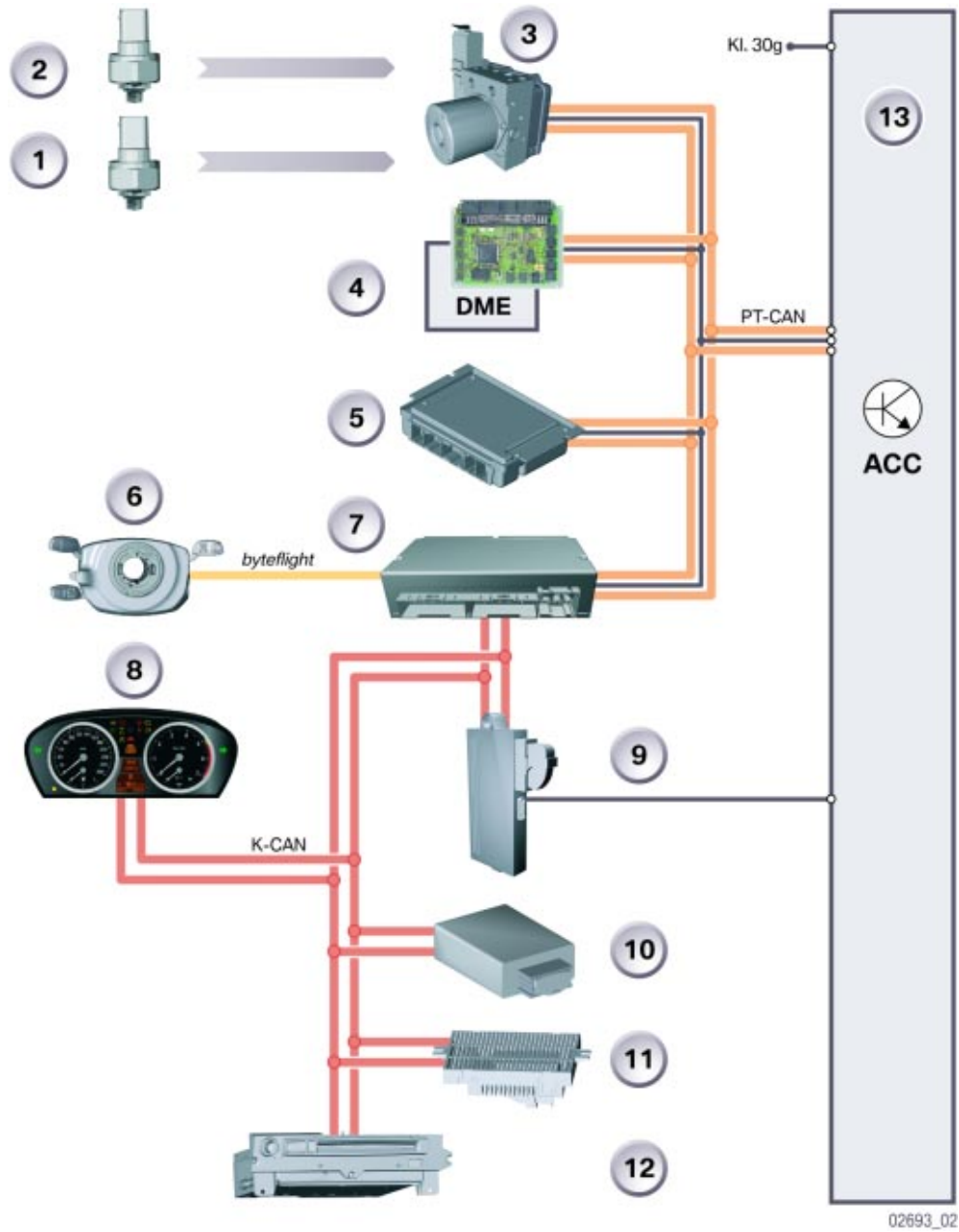
The ACC has the following defining properties:

- Operated from a steering column stalk
- Statuses are shown in the instrument cluster display
- Four selectable increment stages
- Speed preselection in 1 km/h stages
- Sheet steel bracket in the E60 with plastic intermediate holder for the sensor control unit
- Audible instructions to the driver have been omitted

ACC Sensor E60



ACC System Overview



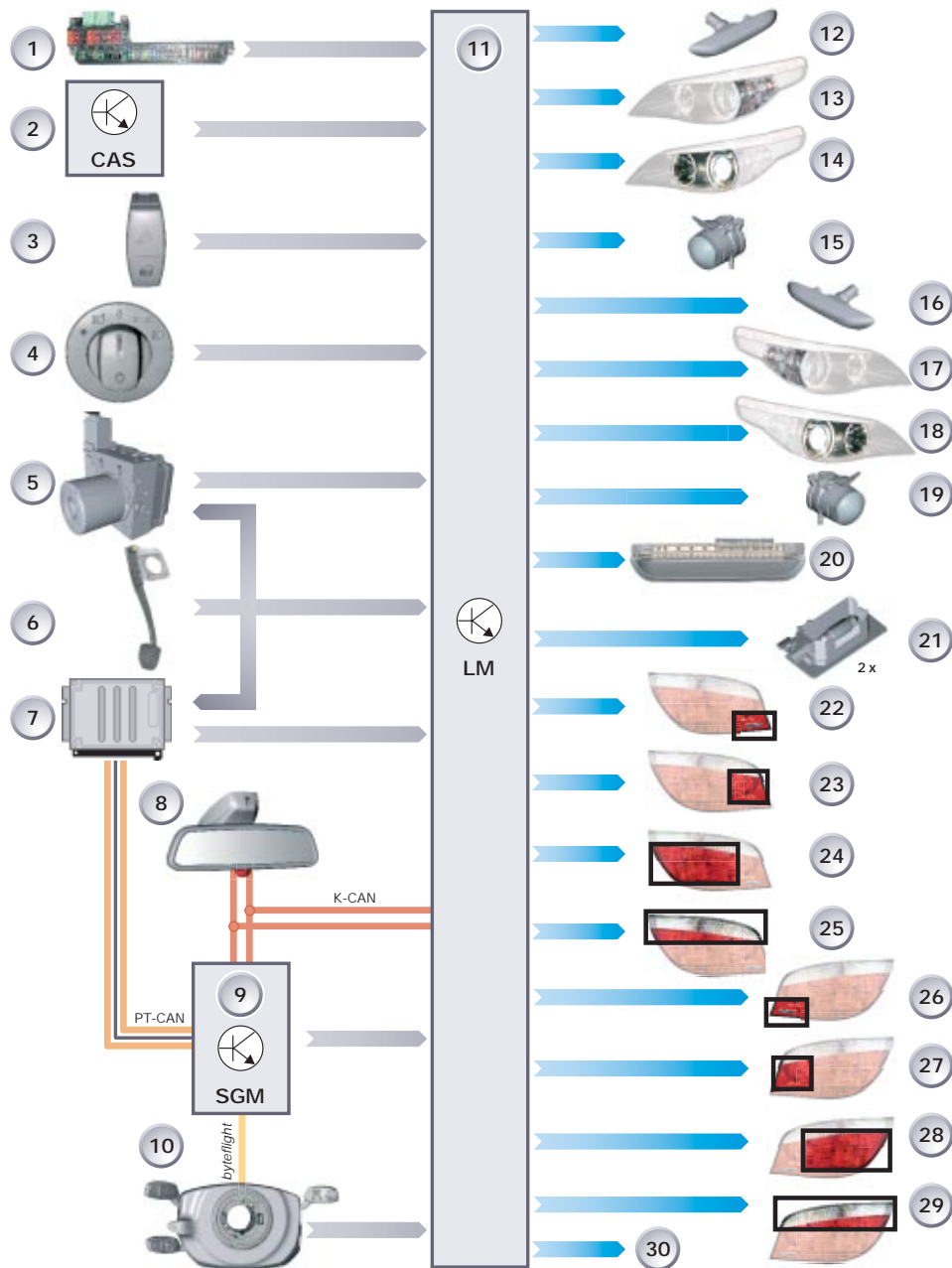
Index	Explanation	Index	Explanation
1	Rear brake pressure sensor	8	Instrument Cluster
2	Front brake pressure sensor	9	CAS
3	DSC	10	Trailer Module (not for US)
4	DME (ECM)	11	Light Module
5	EGS	12	M-ASK
6	SZL	13	ACC Control unit
7	SGM		

Exterior Lights

The exterior lighting is based on the exterior lighting of the E65 and available in the following versions:

- Basic version with halogen headlights
- Adaptive Headlight System (AHL) with bi-xenon headlights

Voltage for all the lights is regulated by the light module. This regulation compensates for fluctuations in vehicle voltage.

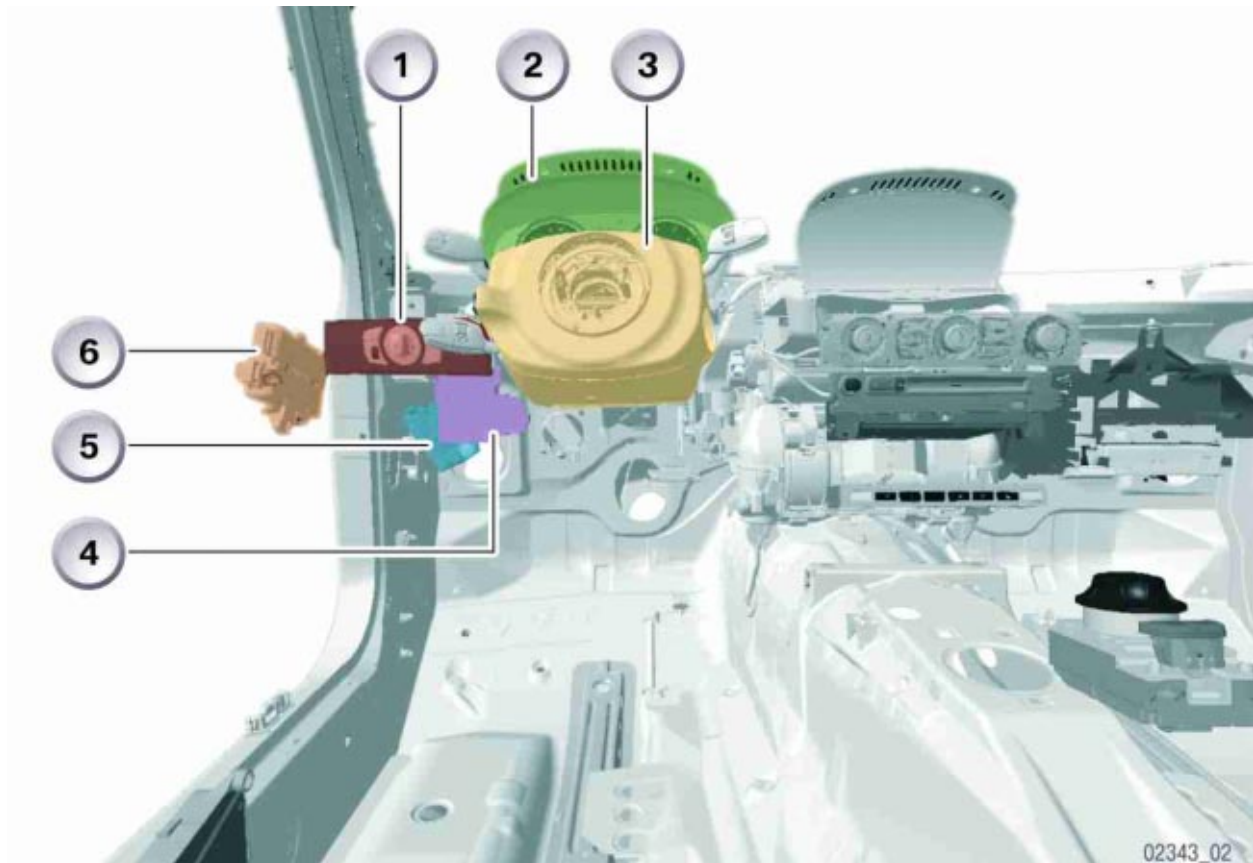


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Components

Light Switch with Control Panel Unit

The light switch is remotely mounted from the light module. They are connected by means of a ribbon cable.



Index	Explanation	Index	Explanation
1	Light Switch	4	CAS
2	Instrument Cluster	5	Light Module
3	SZL	6	TMFA

Brake Light Switch

The car access system supplies the brake light switch with voltage. Signals from the brake light switch are used by the Light Module to activate the brake lights.

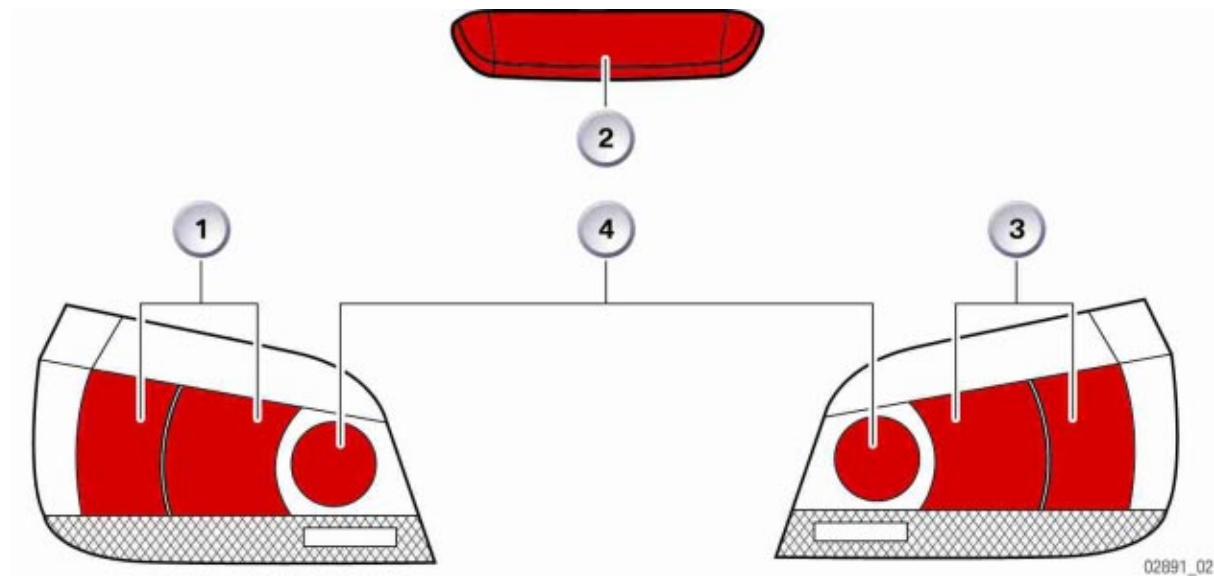
The Light Module also supplies the brake signal to other systems via the K-CAN.

Reverse Lights

On manual transmission vehicles, the signal is made available via a switch from the gear selector lever. The light module controls the reversing lights accordingly.

On automatic transmission vehicles, the signal is made available by the transmission control unit via the PT-CAN.

The signals for reverse gear and the brake light are made available to other subscribers by the light module via the K-CAN.



Index	Explanation	Index	Explanation
1	Left Side brake lights	3	Right Side brake lights
2	Raised (3rd) brake light	4	Brake Force Display (BFD) lights

Brake Force Display

The segments of the rear fog light are used as the BFD as of a deceleration of 5 m/sec^2 .

Service Information

In the E60, the light switch contributes to improved protection for the occupants. This increased level of protection is achieved by artificially enlarging the impact surface of the light switch.

In the event of an accident, a person sitting behind the steering wheel could knock against the light switch with his/her knee for instance. While retaining full functionality, the light switch can be shifted towards the rear. This increases the impact surface about the light switch. After being pressed back, the light switch must be pulled out to move it into the forward position again.

E63/E64 Exterior Lighting

Changes as Compared to E60

The E63/E64 features 2 lamp bulbs in each directional indicator for the front directionals.

The marker light of the E63 is fed from below into the light guide. The hotspot is located at the feed point of the light guide.

The front side markers are equipped with lamp bulbs. LED's are used for the tail lights and brake lights.

Parking Lights ON



Turn Signal ON



Brake Lights ON



Brake Force Display



Brake Force Display

The upper LED's of the rail light are used as the BFD as of a deceleration of 6 m/s^2 .

E61 Tail light

The tail light assembly on the E61 is a split unit with one portion on the rear hatch and the other on the rear quarter panel. The tail light is divided into 7 areas.



Index	Explanation	Index	Explanation
1	Directional indicator	5	Tail light/brake light
2	Two-stage brake light	6	Tail light/brake light
3	Reverse light	7	Side marker light
4	Rear reflector		

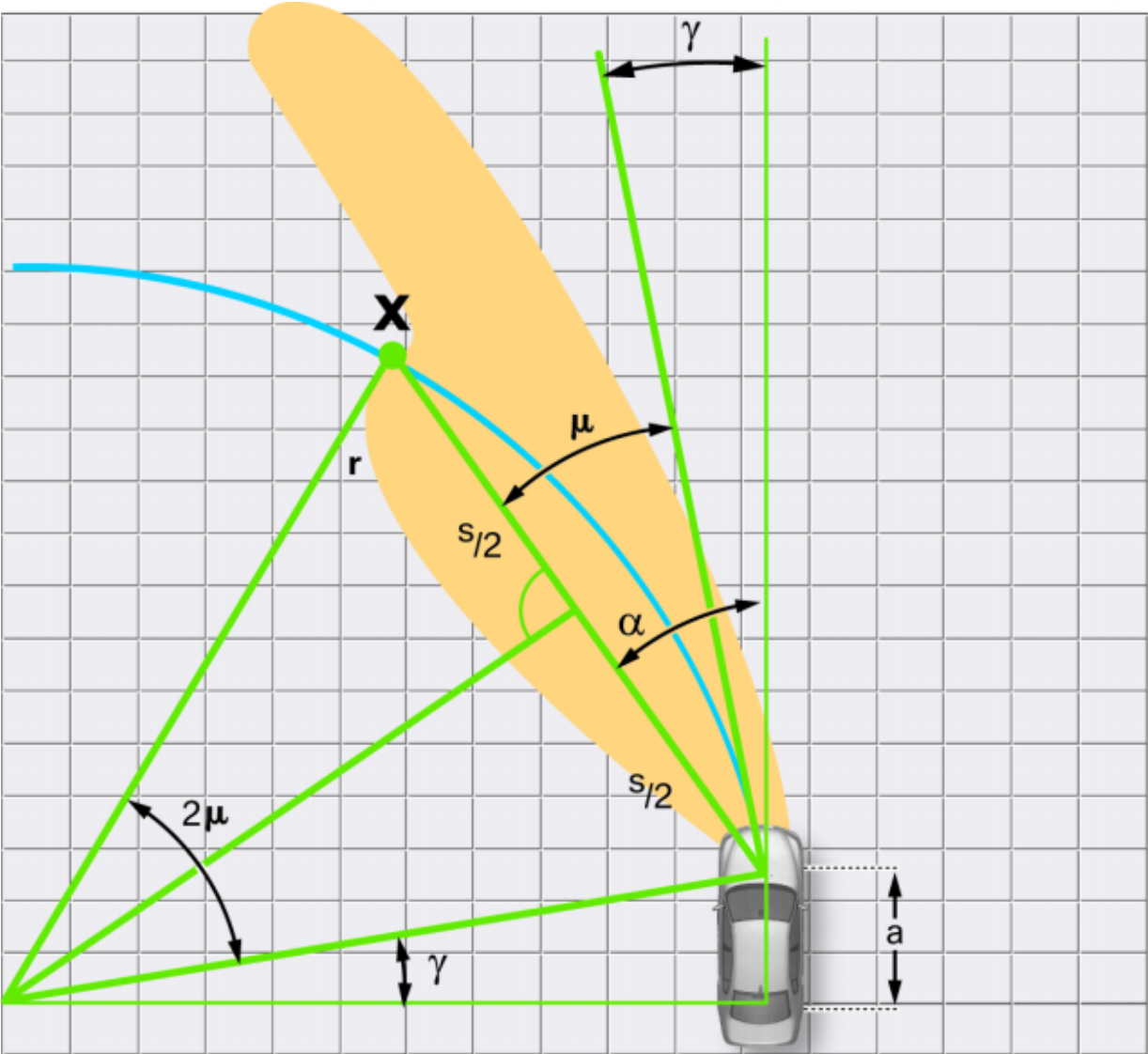
The lamps for the tail light, brake light and directional are located in individual sockets. The center (third) brake light used LED technology and is located in the rear spoiler.

Adaptive Headlights (AHL)

Introduction

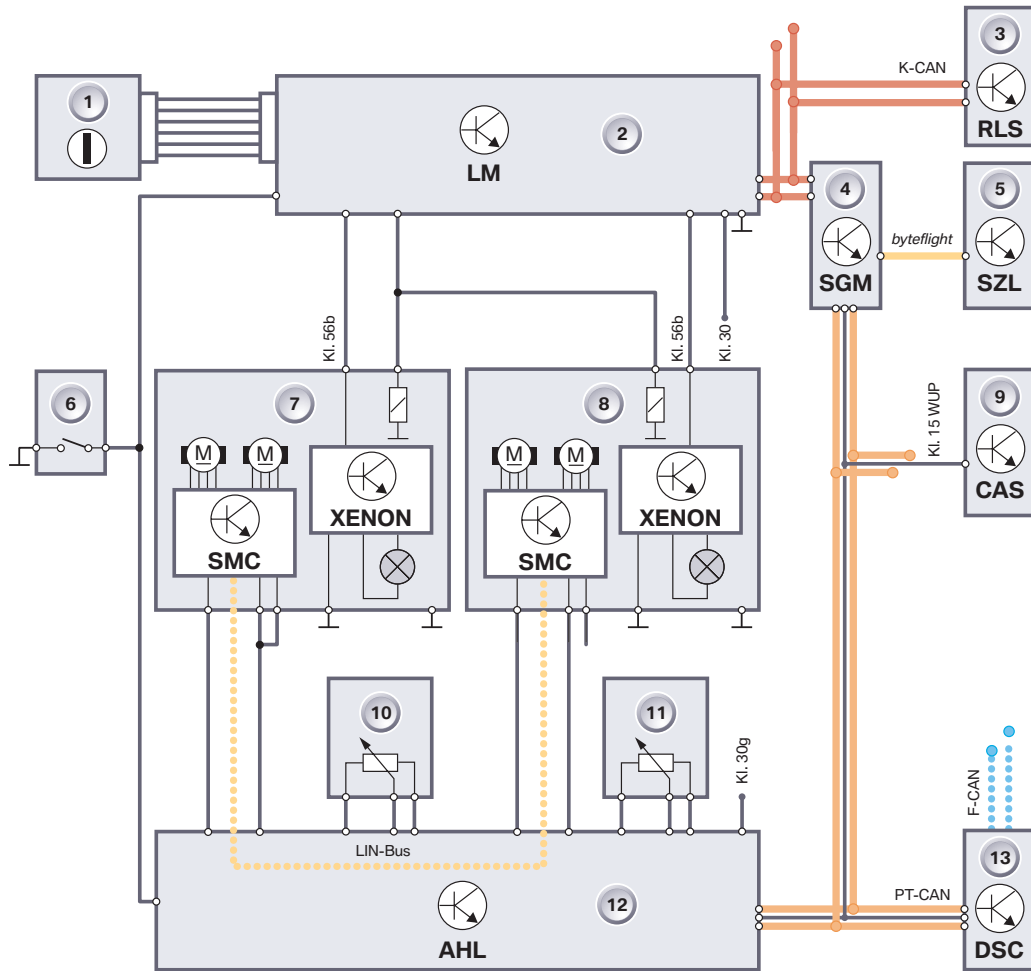
The adaptive headlights system is designed to improve nighttime driving visibility in turns. This is achieved by turning the bi-xenon headlights towards the inside of a bend when cornering. This improves illumination of the curve of the road which in turn, improves to level of visibility for the driver. Without AHL, the driver would be looking into a “black hole” when cornering.

AHL enhances the already existing active safety features. The system collects data regarding vehicle speed, steering angle and rotational speed (yaw) and controls a set of stepper motors to make adjustments to the bi-xenon headlights. AHL also works in conjunction with other vehicle systems via the various bus networks.



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AHL System Overview



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Index	Explanation	Index	Explanation
1	Headlight Switch	8	Right side swivel (positioner) module, includes right headlight assembly. (with SMC/XENON and shutter assembly)
2	Light Module (LM)	9	Car Access System (CAS)
3	Rain and Light Sensor (RLS)	10	Front Level Sensor
4	Safety and Gateway Module (SGM)	11	Rear Level Sensor
5	Steering Column Switch Cluster (SZL)	12	Adaptive Headlight Module (AHL)
6	Brake Light Switch (BLS)	13	Dynamic Stability Control (DSC)
7	Left side swivel (positioner) module, includes left headlight assembly. (with SMC/XENON and shutter assembly)		

Components

Light Switch

The rotary switch for the side lights and dipped-beam (low beam) headlights differs depending on the vehicle equipment level. For the adaptive headlights function to operate, the light switch must be set to position "A". ("A" = "automatic driving lights control" or "adaptive headlights").



Headlight Switch

Direction Indicator/High-beam Switch

The high-beam headlights are switched on and off with the direction indicator/high-beam switch (by pressing or pulling the switch). The adaptive headlights function operates with both dipped and high-beam headlights.

Steering Column Switch Cluster

The control unit in the steering column switch cluster (SZL) forwards the signals from the direction indicator/high-beam switch.



SZL

Signal path:

SZL -> byteflight -> SGM -> K-CAN -> LM

SZL -> byteflight -> SGM -> PT-CAN -> AHL

Ride-height Sensors

The ride-height sensors supply the input signals for the headlight-range adjustment. One ride-height sensor is located on the right-hand side of the front axle. A ride-height sensor is located on the right of the rear axle.

The automatic headlight-range adjustment adapts the height adjustment of the headlights for different operating conditions (e.g. when laden, when braking and when accelerating in dynamic driving situations).

If the special equipment "Adaptive headlights" is fitted, the adaptive headlights control unit evaluates the signals from the ride-height sensors (AHL control unit). This is because: The AHL control unit also controls automatic headlight-range adjustment.



Ride Height Sensor

Brake Light Switch

If the special equipment "Adaptive headlights" is fitted, the signals from the brake light switch are read by the adaptive headlights control unit.

In addition, the brake light switch signal is also an input signal for automatic headlight-range adjustment, see above: ride-height sensors.

Position Sensor (E60, E65, E53)

The position sensor in the positioner module for the bi-xenon headlights supplies a signal indicating the aim of the headlights in the horizontal plane.



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Car Access System

The Car Access System (CAS) supplies input signals with regard to the terminal management (e.g. terminal 15 ON).

The adaptive headlights control unit is activated when terminal 15 is switched ON.

EGS control unit or reversing light switch

When reverse gear is engaged, the headlights are moved to the straight-ahead position.

- On vehicles with automatic transmission, the EGS control unit supplies the relevant signal to the light module (the EGS control unit is the control unit for electronic transmission control).
- On vehicles with manual transmission, the signal is supplied by the reversing light switch.

Rain-light sensor for automatic driving lights control

The rain-light sensor measures the ambient light conditions outside the vehicle.

- As it starts to get dark, the rain-light sensor sends the message "Twilight" to the light module. The light module informs the adaptive headlights control unit so that the automatic headlight-range adjustment of the dipped-beam headlights can be activated. The headlights are tilted up and down as required, but they are not yet swivelled towards the bend in the road.
- In darkness, the rain-light sensor sends the message "Darkness" to the light module. The light module sends the relevant information to the adaptive headlights control unit.

The headlights are swivelled as necessary.

Steering Angle Sensor and DSC Sensor

The steering angle sensor and DSC sensor (DSC = Dynamic Stability Control) supply signals for the adaptive headlights to the adaptive headlights control unit. These signals are evaluated as follows, depending on the vehicle's speed:

- **Vehicle speeds up to 30 km/h** - The adaptive headlights function is controlled on the basis of the information from the steering angle sensor (in the SZL).
- **Vehicle speeds between 30 km/h and 50 km/h** - In the 30 to 50 km/h speed range, there is a continuous transition in signal evaluation: from the evaluation of signals sent by the steering angle sensor to evaluation of the signals sent by the yaw rate sensor (in the DSC sensor).
- **In extreme dynamic driving situations** - (e.g. if the vehicle starts to skid or fishtail), even at speeds less than 50 km/h, the signals from the yaw-rate-sensor are considered. If the vehicle starts to skid or fishtail, the headlights will move to the straight-ahead position. The headlights are not swivelled until the vehicle has stabilized.
- **Vehicle speeds over 50 km/h** - At speeds upwards of 50 km/h, the signals from the yaw rate sensor (in the DSC sensor) form the primary basis for control of the adaptive headlights function.

Reason: for a constant cornering radius, the steering angle required increases over proportionally with increasing speed. In addition, the steering angle required also depends on the coefficient of friction of the road surface.

Yaw rate is directly proportional to speed. For this reason, the yaw rate is always the most suitable measure for controlling the adaptive headlights at high speeds. Even at high speeds, however, the steering angle sensor signal is used to detect (predict) the driver's commands in advance. This is because: The yaw rate signal is not supplied until the vehicle has responded to the steering wheel movement. The steering-angle sensor signal is disabled so that rapid, momentary steering adjustments do not affect the adaptive headlights function.

AHL Control Unit on E60, E63

The AHL control unit is responsible for the vertical and horizontal adjustment of the bi-xenon headlights. For safety reasons, the AHL control unit is also responsible for the LWR (automatic headlight-range adjustment) for vertical adjustment).

The AHL control unit is connected to the PT-CAN and is located in the control module carrier behind the glove compartment.

Stepper Motor Controllers

The stepper motor controllers (SMCs) control the stepper motors in the headlights for the AHL functions (L/R) as well as the LWR functions (Vertical). The SMC control units communicate with the AHL control module via the LIN bus.

Light Module

On the E60, the light module (LM) controls and monitors all vehicle lights. Information is transmitted and received via the K-CAN data bus. The light module is responsible for the actuation of the indicator light for AHL (on the light switch).

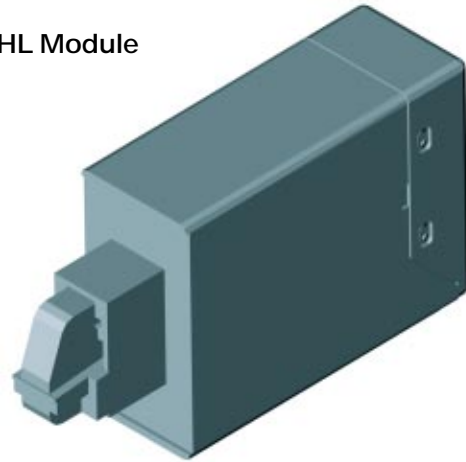
Safety and Gateway Module

On the E60, the safety and gateway module (SGM) is the interface between the two data buses K-CAN and PT-CAN. Thus, all information exchanged between the light module and the AHL control unit passes through the SGM. Information from the yaw rate sensor (in the DSC sensor) is also fed through the SGM to the AHL control unit.

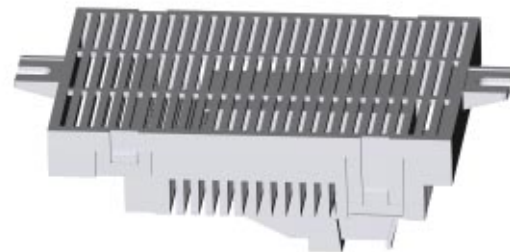
Xenon-headlight Control Unit

The xenon-headlight control unit monitors the D2-S bulbs for the bi-xenon headlights.

AHL Module



Light Module



SGM

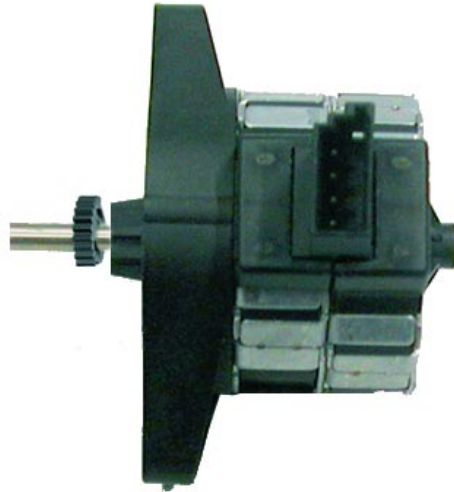


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Stepper Motors for the Adaptive Headlights

The stepper motors turn the positioner modules in the bi-xenon headlights.

The stepper motors turn the headlights vertically and horizontally (vertically = for the automatic headlight-range adjustment and horizontally for adaptive headlights).



Function Indicator (On Light Switch)

The function of the AHL is indicated by the FLC LED lighting permanently. A fault in the AHL system is indicated by the FLC LED flashing with the AHL active.

The green FLC LED has two functions:

- The LED lights up permanently when the light switch is set to position "A". The AHL and LWR systems are active when the LED is on solid.
- The LED flashes if a fault develops in the adaptive headlight system.

The LED actuated by the light module.

The low beam headlight and the headlight vertical aim control (LWR) remain active in the case of fault. The swivel function of the bi-xenon modules is deactivated.

A reference run is performed during every new start. If a defect is found, the bi-xenon headlights are switched off to ensure oncoming traffic cannot be dazzled. The fog lights are switched on as a substitute function.

Principle of Operation

The adaptive headlights system adjusts the horizontal aim of the headlights (i.e. from side to side) in order to illuminate the inside of a bend when cornering.

The following functions of the adaptive headlights system are described below:

- System activation and calibration sequence
- Activation of stepper motor controllers (SMC)
- Speed-dependent analysis of input signals
- Horizontal swivelling of the headlights by the stepper motor controller
- Deactivation of adaptive headlight movements under extreme driving conditions
- Deactivation of adaptive headlight movements in response to system faults
- Setting headlights to parked position
- Activation of automatic headlight-range adjustment by the AHL control unit
- Adaptive headlights for automatic driving lights control

System Activation and Calibration Sequence

When terminal 15 is switched ON, the headlights always perform a calibration sequence, even if the lights are not switched on. The AHL control unit sends the "perform calibration sequence" request to the stepper motor controllers (SMCs, control units for the headlight stepper motors). The stepper motor controllers actuate the stepper motors in the headlights. The calibration sequence is performed. During the calibration sequence, the headlights move in the following manner:

- The headlights move horizontally (= calibration sequence for the AHL).
- The headlights move vertically (= calibration sequence for the headlight-range adjustment function).
- At the end of the calibration sequence, the headlights are in the straight-ahead position.

Following the calibration sequence, the system is ready for operation.

When reverse gear is engaged, the headlights are moved to the straight-ahead position.

Note: The calibration sequence is performed only after terminal 15 has been switched OFF for at least 15 seconds.

If terminal 15 is switched on and off repeatedly (for example, for demonstration reasons), the headlights are not calibrated each time terminal 15 is switched on.

Terminal 15 must have been switched off for at least 15 seconds before it is switched on again. Only then is a calibration sequence performed when terminal 15 is switched on.

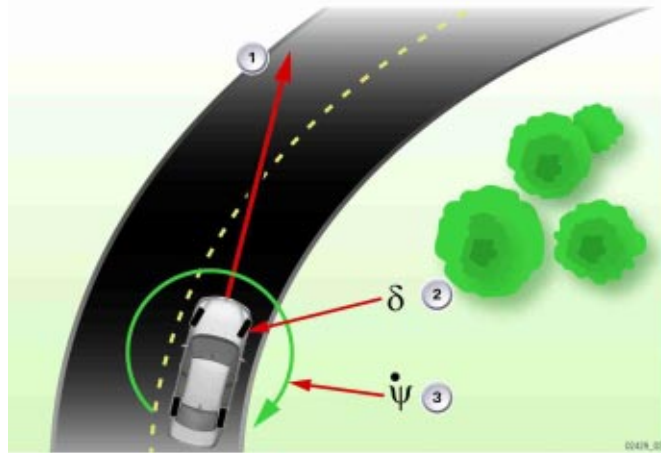
Activation of Stepper Motor Controllers

The AHL control unit transmits the nominal values for the positioner modules (position and speed of movement of the positioner modules) to the stepper motor controllers (SMC). The AHL control unit calculates the nominal values on the basis of the following input signals:

- Vehicle road speed
- Steering angle (at speeds up to 50 km/h, depending on programming) (50km/h = 31mph)
- Yaw rate (above 50 km/h, see "Steering-angle sensor and DSC sensor" above)

Speed Dependent Analysis of Input Signals

The adaptive headlights are controlled based on input from the steering angle sensor and the yaw rate sensor. The AHL control will use these signals on a priority basis depending upon road speed.



1. Vehicle Speed
2. Steering Angle
3. Yaw (rotation)

The encoding process performed at the end of the production line determines the priority assigned to sensor signals above which speed threshold (see above).

Horizontal swivelling of the headlights by the stepper motor controller

Horizontal range of movement of headlights

- Inwards, i.e. towards center of vehicle: up to a maximum of 8°
- Outwards: up to max. 15°

That means in a right-hand bend the right-hand headlight turns by up to 15° (the right-hand headlight is the "inside" headlight on a right-hand bend. It therefore swivels outwards away from the vehicle center).

The left-hand headlight swivels through a maximum of 8° (the left-hand headlight swivels towards the vehicle center, i.e. inwards).

The headlight on the outside of the bend reaches its end position at the same time as the headlight on the inside of the bend, ensuring that the road is evenly illuminated.

On a right-hand bend, the left-hand headlight is on the outside of the bend. The right-hand headlight is on the inside of the bend.

Deactivation of adaptive headlight movements under extreme driving conditions

If the vehicle starts to skid and fishtail, the swivelling movement of the adaptive headlights is deactivated as follows:

- The headlights are returned to the straight-ahead position. The headlights are no longer turned.
- The lights remain on.

Deactivation of adaptive headlight movements in response to system faults

If a system fault occurs, the green indicator lamp on the light switch flashes. Dazzling of oncoming traffic must be prevented in the event of a system fault. To this end, the swivelling movement of the adaptive headlights is deactivated as follows:

- If the stepper motors are still functional, the headlights are returned to the straight-ahead position. The headlights are no longer swivelled towards bends in the road.
- If it is no longer possible for a headlight to be moved back to the straight-ahead position, the headlight is tilted downwards (by the stepped motors for automatic headlight-range adjustment). This prevents dazzling of oncoming traffic.
- If the headlight cannot be tilted downwards, the bi-xenon bulb in this headlight is disabled as follows:
 - When the vehicle is parked, the AHL control unit recognizes sleep mode (stand still plus terminal R OFF for several minutes).
 - The next time the vehicle is restarted, the bi-xenon light of the defective headlight is not switched on.
 - The front foglights are switched on in order to ensure a minimum level of illumination.
 - The dipped-beam headlights are not switched off while the vehicle is in motion.

Setting Headlights to Parked Position

When terminal R is switched off, the headlights move to the parked position. The parked position is important for the headlights' next calibration sequence: from the parked position, the headlights are run through a calibration sequence in the pre-drive-check. During each calibration sequence, the AHL control unit relearns the straight-ahead position for the headlights.

When the headlights have reached the parked position, the stepper motor controllers (SMCs) inform the AHL control unit ("acknowledge").

The AHL control unit deactivates the stepper motor controllers.

The run-down period lasts approximately 10 seconds.

Activation of automatic headlight-range adjustment by the AHL control unit

If special equipment "Adaptive headlights" is fitted, the AHL control unit also controls the automatic headlight-range adjustment.

The automatic headlight-range adjustment adapts the headlight range for different operating conditions. Variations in the vehicle tilt angle are produced by vehicle loads and braking or acceleration in extreme driving situations. The automatic headlight-range adjustment tilts the headlights up and down as required.

The AHL control unit controls the automatic headlight-range adjustment as follows:

1. The ride-height sensors and the brake light switch send the input signals for the headlight-range adjustment to the AHL control unit.
2. From the input signals received, the AHL control unit calculates the vehicle tilt angle (along the longitudinal axis, relative to the road surface).
3. Using the stepper motors for moving the headlights vertically, the headlight range is adjusted automatically and dynamically.

The headlight range is adjusted so that the actual headlight range conforms to the legally required headlight range as follows:

- **If vehicle rear is lower than front** - The actual headlight range will be longer than the legally stipulated range. The headlight beam height is lowered to reduce the headlight range to match the legal requirement.
- **If the vehicle is horizontal** - The actual headlight range will be the same as the legally stipulated range.
- **If vehicle front is lower than rear** - The actual headlight range will be shorter than the legally stipulated range. The headlight beam height is raised to increase the headlight range to match the legal requirement.

Adaptive headlights for automatic driving lights control

The automatic driving lights control feature (option in conjunction with the RLS) automatically switches the side lights and dipped-beam headlights on and off.

Switch-on conditions:

- The light module must be encoded with automatic driving lights control.
- The light switch must be in position "A" ("A" for automatic driving lights control or adaptive headlights).
- The rain-light sensor must be installed and operational.

The rain-light sensor detects the brightness of the ambient light. The rain-light sensor sends the following requests to the light module:

- Low ambient brightness (twilight, darkness, in a low-level garage or tunnel): "switch on dipped-beam headlights" request.
- Sufficient ambient brightness: "switch off dipped-beam headlights" request.

If only the side (parking) lights are to be switched on, the light switch must be set to side lights (switch position 1).

When the light switch is set to position "A", the AHL control unit is also activated:

- When the automatic driving lights control function switches on the dipped-beam headlights (e.g. at dawn/dusk), the adaptive headlights function is notified at the same time.
The light module sends the message "Dipped headlights on" to the AHL control unit (and the AHL control unit takes over control of automatic headlight-range adjustment).
- The light module also takes account of the signals from the rain-light sensor.
The headlights are not turned when the vehicle is cornering until total darkness sets in.

The message "Dipped (low beam) headlights on" is generated separately for each headlight unit.

If a headlight fails, the movement of the adaptive headlights is suspended.

The front foglights are switched on in order to ensure a minimum level of illumination.

Switch-on Conditions

When terminal 15 is switched ON, the AHL control unit "wakes up". The swivelling of the lights is subject to the following conditions:

- Reverse gear must not be engaged.
- No system faults must be present. The indicator light must not be flashing.
- The D2-S bulbs in both headlight units must be working (the D2-S bulbs are the bulbs for the xenon headlights).
- The vehicle must not be skidding or fishtailing.
- The rain-light sensor must detect darkness.
- Additional precondition for activation: automatic driving lights control is active (light switch in position "A", see above).

Workshop Hints

Various repairs may be necessary during the course of vehicle's service life. As a consequence of repair work, it may be that the system parts for the AHL are installed with different software and hardware versions. In each case, the replaced components must be adapted to the specific requirements of the vehicle.

AHL Control Unit

After replacing an AHL control unit, it is necessary to enter the vehicle identification number and to encode the control unit depending on specific vehicle data.

The complete AHL function will not be operative if adaptation to the vehicle is not performed.

Replacing SMC

After replacing the SMC, it is necessary to enter the vehicle identification number and headlight-dependent coding in the SMC control unit.

The complete AHL function will remain inoperative if this adaptation is not performed.

Particular care must be taken when replacing the SMC to ensure that the housing seal of the SMC is fitted correctly.

Replace Bi-Xenon Headlights

After replacing the bi-xenon headlights, it is necessary to encode the corresponding SMC depending on the headlights.

If this adaptation is not performed, the function will appear to be operative but not correct. The swivel range and zero point can vary from vehicle model to vehicle model and the bi-xenon headlight can have a different status!

The headlights must be adjusted and checked.

Diagnosis

The AHL system must be set to diagnosis mode in order to perform the following jobs:

- Read out of relevant bus signals with vehicle stationary
 - Road speed
 - Yaw rate
 - Steering angle
- Checking signal plausibility
- Checking that conditions for activation are fulfilled
 - Rain and light sensor status
 - Light switch status

Missing or non-plausible BUS signals are stored in the form of fault codes in the AHL control unit. The types of fault are stored in the SMC. The SMCs are accessed via the AHL control unit.



Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the complaint outlined below. Complete worksheet using the "Complaint, Cause, Correction" format.

Vehicle: _____ Chassis #: _____ Production Date: _____

Complaint:

Cause:

Correction:



Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the complaint outlined below. Complete worksheet using the "Complaint, Cause, Correction" format.

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Workshop Exercise - Diagnosis

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Complaint:

Cause:

Correction:



Classroom Exercise - Review Questions

1. What is the difference between the alarm siren on the E60 compared to the E63/E64?

2. On the E60 DWA system, What signal does the IHKA module send to DWA and Why?

3. Under what conditions will PDC be switched "OFF"?

4. What is BFD? Explain

5. What are the three main input variables for AHL?



Classroom Exercise - Review Questions

6. Explain the signal path between the turn signal switch and the AHL module?

7. What are the two functions of the Green LED on the light switch (AHL equipped vehicles)?

Notes:

Interior Lighting

The interior lights of the E60 are pulse width modulated and automatically controlled by various inputs.

PWM Control

The output is active from terminal 15 with a permanent clocking in a frequency of 100 Hz. In this way the power output is controlled. From a voltage of 12.8 V the pulse width modulation is adjusted in such a way as to provide a power output of 100% as for 12.8 V.

In the case of voltage drops in the vehicle electrical system of up to 1 V, the pulse width modulation is corrected and thus a constant brightness of the lamps connected at the consumer shutdown output is ensured.

Below 12.8 V voltage regulation is no longer corrected. The brightness can fluctuate with the battery voltage level.

Consumer Shutdown Terminal

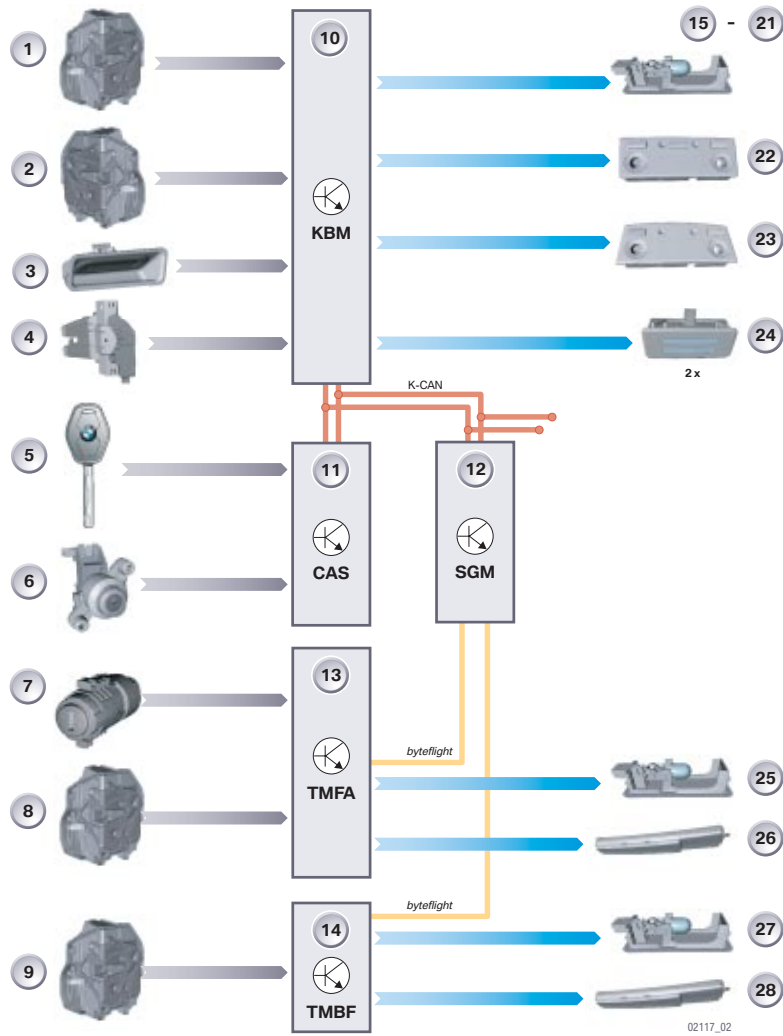
Some loads/consumers such as reading, glovebox and luggage compartment lights can remain switched on when the car is stopped. In order to protect the battery, these consumers are shut down after a drop at terminal R with a delay of 16 minutes. or immediately with the diagnosis telegram.

Consumer Shutdown

Power outputs are made available by the KBM 2 for consumer shutdown.

- VA 1 (Output 1):
 - Reading lights
 - Vanity lights
 - Boot
- IB 2 (Output 2):
 - Glovebox light

System Overview Interior Lighting



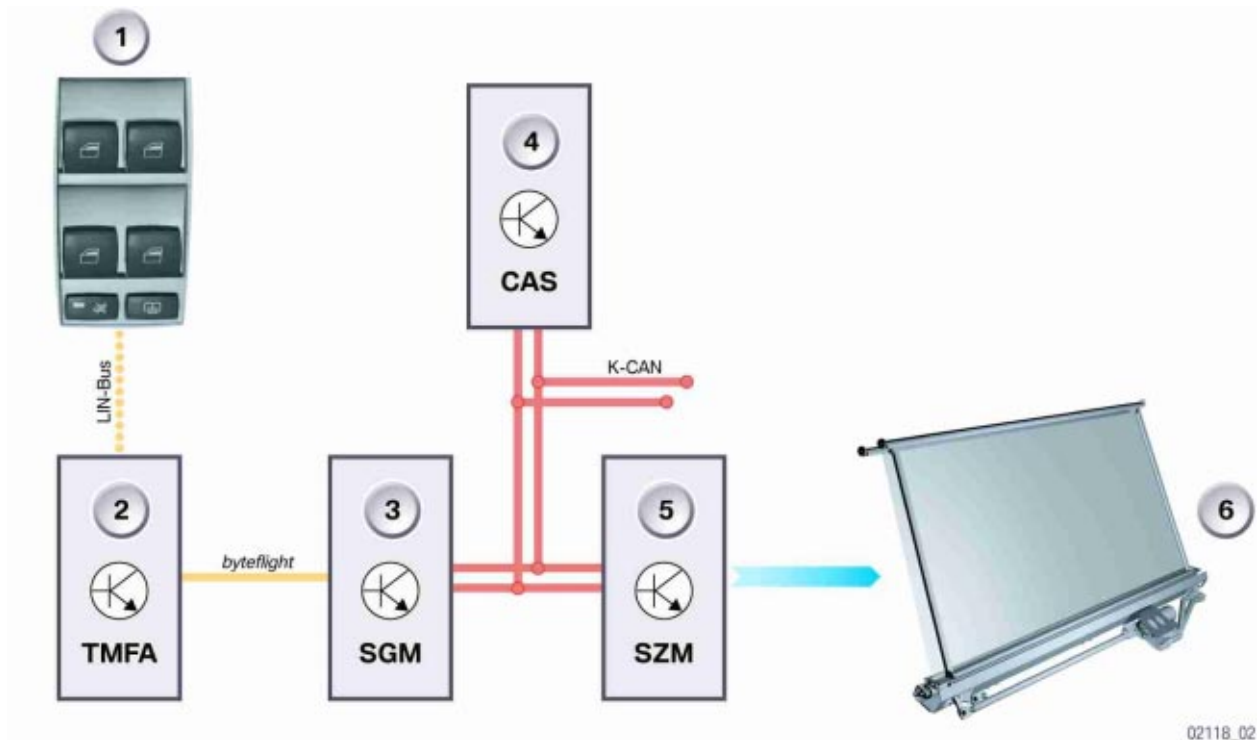
Index	Explanation	Index	Explanation
1	Door contact, rear driver's side door	15	Footwell light, driver, front
2	Door contact, rear passenger side door	16	Footwell light, passenger front
3	Button, trunk lid exterior	17	Glovebox lighting
4	Central locking, tailgate	18	Exit light, driver, rear
5	Remote control	19	Exit light, passenger, rear
6	Lock cylinder, tailgate	20	Luggage compartment light
7	Lock cylinder, driver's door	21	Luggage compartment light
8	Door contact, driver's door front	22	Interior reading lights, front
9	Door contact, passenger door, front	23	Interior reading lights, rear
10	Body Basic Module (KBM)	24	Vanity light, driver/passenger
11	Car Access System (CAS)	25	Exit light, driver's side
12	Safety and Gateway Module (SGM)	26	Front area light, driver
13	Door module TMFA, driver front	27	Exit light, driver's side
14	Door module TMBF, passenger front	28	Front area light, passenger side

Roller Sunblind

An electric roller sunblind is available for the rear window of the E60. Mechanical roller sunblinds are also available for the side windows of the E60.

System Function

The roller sunblind is operated from the switch in the driver's side switch block.



Index	Explanation	Index	Explanation
1	Driver's door switchblock	4	Car Access System
2	Driver's door module	5	Center Console Switch Center (SZM)
3	Safety and Gateway Module (SGM)	6	Roller Sunblind

Seats

Seat Variants

Three different seat versions are available for the E60.

- Electric basic seat with memory
- Electric sports seat with memory
- Multi-function seat with memory

Provision is also made for the installation of various options:

- Electric seat heater
- Seat ventilation system
- Active seat option
- Lumbar support option

Electrical Interfaces

One 8-pin and one 25-pin connector are used to connect the system to the vehicle electrical system. The pin assignment of the 10 compartment plug connections has not changed from those for the seats in the E65. The 6 compartment plug connections for the seat modules have not changed either.

Electric, Sport and Multi-Function Seats

The signals required for seat adjustment are generated with the aid of the adjustment switches. The signals are forwarded to the center console switch center (SZM) by means of an interface similar to a K-Bus. The center console switch center then forwards the data to the seat modules via the K-CAN.

Signals are processed in the seat modules. With the aid of the output stage in the seat modules, the motors in the seat are activated for seat adjustment.

Seat Heating

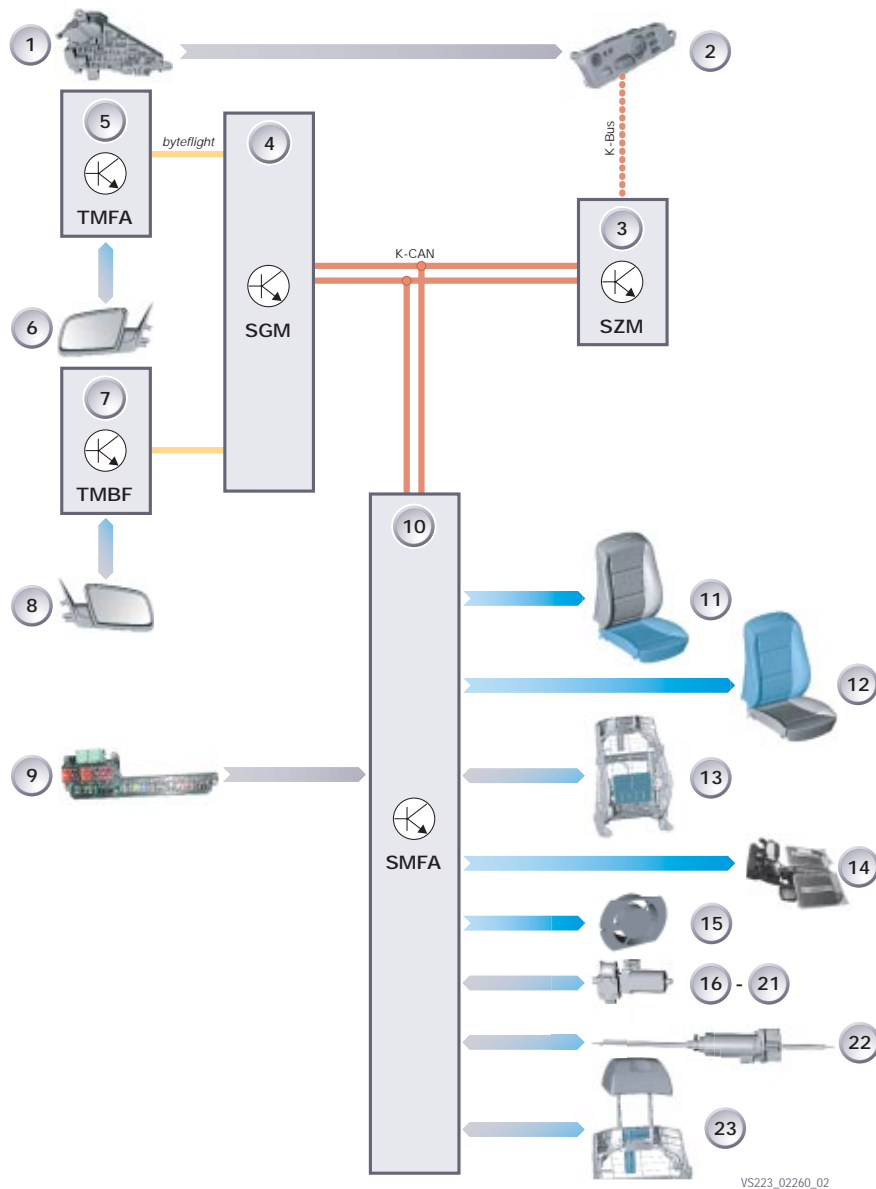
The heating circuits vary depending on the equipment fitted. The multifunction seat and the option seat ventilation system have 4 heating circuits. In a 4 heating circuit system, the backrest and seat cushion each have a rapid-heat area and a secondary heat area. Each heat area is fitted with a temperature sensor. Current is applied to a maximum of two heating circuits at any one time.

Seat variants that are not based on the multi-function seat and that are not fitted with the option seat ventilation system have 2 heat circuits. In a 2 heating circuit system, the backrest and seat cushion each have one heat area.

Lumbar Support

The seats are fitted with a pneumatically operated lumbar support adjustment.

Seat System Overview (Multifunction Seat example)



VS223_02260_02

Index	Explanation	Index	Explanation
1	Power distribution, front	10	Driver's seat module (SMFA)
2	Seat switch panel	11	Seat heating (Seat bottom)
3	Center Console Switch Center (SZM)	12	Seat heating (Backrest)
4	Safety and Gateway Module (SGM)	13	Lumbar support
5	Driver's Door Module (TMFA)	14	Active seat
6	Exterior mirror, driver	15	Fan motors, ventilated seat
7	Passenger door module (TMBF)	16-22	Seat adjustment motors
8	Exterior mirror, passenger side	23	Head restraint adjustment
9	Power distribution, front		

Active Seat

The active seat is already described in the training material for the E65. To provide support and relieve the strain on the spinal column and back muscles during long journeys, the active seat can be installed in the vehicle (Refer to the Active Seat section in the E65 training material).

Entry/Exit Function for the Multi-Function Seat

There is an entry/exit aid for both the driver and passenger. The entry/exit aid is available in conjunction with the multi-function seat. The entry/exit aid system uses the backrest width (LBV) and seat cushion depth (STV) adjustment functions.

The backrest width is retracted to allow entry/exit into the vehicle. This creates more space in the area of the backrest. The seat cushion depth is reduced. This creates more space around the seat area.

Functional Principle

One example in which the entry/exit aid is activated

The customer stops the vehicle. The vehicle is not in gear, the engine is either running or switched off. The vehicle door is opened. The door contact indicates this. The exit aid is activated. The LBV and then the STV are retracted. The customer gets out and the door is closed. The exit aid remains in that position and is used to assist entry when the customer gets back in the car.

Seats E63/E64

Introduction

The E63 and E64 will feature electrically adjustable driver's and passenger's seats as standard.



Electrically adjustable sports seats will be optionally available. The sports seats additionally feature a manual seat depth adjustment facility, more pronouncedly formed seat upholstery and a lumbar support.

The electrical control is identical for both the basic seat and sport seat. Both versions include seat memory on the driver's side.

The K-Bus connects the driver's seat module (SMFA) to the SZM. In the E64, the passenger's seat module (SMBF) is also connected to this K-Bus.

The SZM represents the interface between the K-Bus of the seats and the K-CAN. The K-CAN and SZM therefore connect the seat control units to the control units of the body electronic systems.

Components

The system features the following switches and sensors:

Seat Adjustment Buttons

The seat adjustment buttons are located on the outer sides of the seat cushions. They vary in terms of number and function. The E64 seat is additionally equipped with an option for electrically adjusting the head restraints (headrests).

Lumbar Support Button

A rocker switch is provided on the seat to adjust the lumbar support.

Seat Memory Button

Only the driver's seat features additional buttons for the seat memory.

Seat Heating Switch

The buttons for controlling the seat heating are included in the center console switch cluster.

Hall Sensors

Hall sensors are installed for the purpose of detecting the position of the seats. The sensors are integrated in the seat drive units.

Temperature Sensor for Seat Heating

A temperature sensor is installed in each of the seat cushions for the seat heating.

The seats are controlled by the following control units:

Center Console Switch Cluster (SZM)

In addition to the switches, the electronic circuits for the heating control and monitoring functions are integrated in the center console switch cluster (SZM). The SZM is also responsible for the electronic control of the steering column adjustment function.

E63/E64 Driver's Seat Module

The control unit of the driver's seat module (SMFA) communicates via the K-Bus with the center console switch cluster (SZM).

Passenger's Seat Module, E64 Only

The control unit of the passenger's seat module (SMBF) communicates via the K-Bus with the center console switch cluster (SZM).

In the E63 the drive units are controlled directly by a load circuit.

The following actuators are driven to perform the seat functions:

Seat Heating

The seat cushion heating and backrest heating are installed such that they cover the entire area. Even the side sections and thigh supports are heated:

Seat Adjustment Drive Units

The following drive units are installed in the E63 and E64 seat:

- Drive unit for seat forward/backward adjustment with 2 adjustment speeds
- Drive unit for seat height adjustment
- Drive unit for seat cushion tilt adjustment
- Drive unit for backrest angle adjustment

Additionally installed in the E64:

- Drive unit for head restraint height adjustment

Head Restraint Angle Adjustment

The head restraint angle adjustment as well as the seat depth adjustment on the sports seat are always manual.

Lumbar Support

The lumbar support in the seat backrest consists of 2 lumbar cushions as well as an electric air pump with electrically operated valves.

The following displays provide seat status information:

Central Information Display

A corresponding check control message is shown on the central information display (CID) when, for example, a backrest is not locked in correctly (E64 only).

Head-up Display

A corresponding check control message and an information text are shown in the head-up display (HUD) when the backrest is not locked in correctly (E64 only).

Seat Heating LEDs

3 light emitting diodes (LEDs) in the center console switch cluster indicate the switched status of the seat heating system.

Seat communication features the following bus systems:

K-CAN

The body controller area network (K-CAN) is a two-wire bus for communication between all control units connected to the K-CAN.

K-Bus

The body bus (K-Bus) is a single-wire connection. The center console switch cluster and the seat modules communicate with each other via the K-Bus.

Principle of Operation

The system functions of the electrically operated seats include:

- Seat adjustment
- Rear easy-entry facility
- Seat heating

Seat Adjustment

The installed seats feature the following seat adjustment options:

- Seat forward/backward adjustment (with electric drive unit, 2 speed stages)
- Seat height adjustment (with electric drive unit)
- Seat depth adjustment (manual only, sports seat only)
- Backrest angle adjustment (with electric drive unit)
- Head restraint height adjustment (E63: manual; E64: with electric drive unit)
- Head restraint angle adjustment (manual only)
- Lumbar support height adjustment (electro-pneumatic)
- Lumbar support depth adjustment (electro-pneumatic) [more ...]

The standard seat forward/backward adjustment, seat height adjustment, seat cushion tilt adjustment and backrest angle adjustment facilities are each operated with separate electric drive units in all seats. The head restraint height adjustment is driven by an electric drive unit only on the E64.

All these functions are controlled via the control panel on the outer sides of the seat cushions. Signals from the respective button trigger seat adjustment in the required directions.

A separate rocker switch is used to operate the lumbar support. An electric pump supplies the lumbar support cushion with compressed air. The individual air chambers are filled or emptied via several valves to vary the height and thickness of the lumbar support.

The limit stop is calculated for each drive unit in order to reduce the load of the electric drive units to a minimum. Automatic recognition of the limit stops is integrated in each of the electric drive units. Hall sensors integrated in the drive units register the adjustment distances which are processed in the seat module. In the event of the drive unit blocking, the detected position value is interpreted as the limit stop. All subsequent adjustments are interrupted just before this point.

Once the obstruction has been removed, adjustment can again extend beyond the newly detected limit stop when the seat adjustment button is pressed again.

Rear Easy-entry Facility

The rear easy-entry facility is controlled by a push-button on the seat backrest. The rear easy-entry facility can be activated only under the following conditions:

- The vehicle must be stationary with no wheels turning
- The door must be opened

Rapid adjustment is achieved with the second speed stage of the drive unit for seat forward/backward adjustment. The seat moves for as long as the button is pressed. At the same time, the backrest can be released manually and folded forward.

The seat moves back to its initial position when the seat adjustment button is pressed back.

Seat Heating

The seat heating system heats the seat cushion and backrest including the side sections. Separate seat heating switches (push-buttons) in the center console switch cluster (SZM) control the driver's seat and passenger's seat.

The center console switch cluster controls the seat heating electronically. The system is monitored by a temperature sensor. The seat heating is operational as from terminal 15 "ON".

3 LEDs located above the seat heating switches indicate the heating stage currently active in the seat heating system.

Note: The seat heating is not actuated while the steering column is adjusted.

The current at the center console switch cluster would be too high if the seat heating and steering column adjustment were operated simultaneously. The seat heating is interrupted in order to protect the center console switch cluster (SZM).

E63/E64 Seat Heating

■ Installation Location

The heating mats of the heating system are integrated in the seat cover. The electronic circuits and push-buttons necessary for operating the seat heating system are integrated in the center console switch cluster (SZM).



Index	Explanation	Index	Explanation
1	Temperature sensor in seat cushion	6	Heating mat in backrest
2	Heating mat in seat cushion	7	Seat and backrest upholstery
3	Heating mat in thigh support	8	Head restraint
4	Heating mat in side sections of seat cushion	9	Seat frame
5	Heating mat in side sections of backrest	10	Thigh support

■ Construction

The seat heating system consists of a carbon fibre net integrated in the seat covers. The heating mats are also integrated in the thigh support and side sections of the seats. The head restraint (headrest) is not heated.

There is a direct line from the center console switch cluster (SZM) to the heating mats for control purposes. A temperature sensor in the seat measures the current temperature.

Function of Seat Heating

The heating mats for the driver's seat and passenger's seat are controlled separately. The heating stage is selected with the seat heating switches in the center console switch cluster. The seat heating is operational as from terminal 15 ON. The heating stage is selected by pressing the seat heating switch several times. 3 green light emitting diodes (LEDs) above the seat heating switches indicate the status of the seat heating system.

Operate the seat heating systems as described in the Owner's Handbook.

Note: The seat heating is interrupted when steering column adjustment is activated.

The seat heating is interrupted in order to protect the SZM. The current at the SZM would be too high if the seat heating and steering column adjustment were operated simultaneously, posing a risk of irreparable damage to the electronic circuitry.

The seat heating system features the following functions:

- Seat heating ON and OFF
- Seat heating temperature control
- Monitoring of temperature sensor
- Seat heating output management
- Overvoltage/undervoltage detection
- Short-circuit detection
- No-load detection
- Plausibility check of temperature profile

■ Seat Heating ON and OFF

Separate seat heating switches (push-buttons) in the center console switch cluster (SZM) control heating stages for the driver's seat and passenger's seat as follows:

- Switch briefly pressed 1x: Seat heating stage 3 ON > 3 LEDs ON
- Switch briefly pressed 2x: Seat heating stage 2 ON > 2 LEDs ON
- Switch briefly pressed 3x: Seat heating stage 1 ON > 1 LED ON
- Switch pressed 1x long: Seat heating OFF > LEDs OFF

The seat heating can be switched off in any stage by pressing the button for longer than 1.2 seconds. The LED indicators are located above the seat heating switch.

■ Seat Heating Temperature Control

An electronic temperature control circuit is integrated in the SZM. A temperature sensor is integrated in the heating mat for the purpose of registering the seat temperature.

The seat heating is deactivated at terminal 15 OFF. The selected heating stage remains stored for a further 15 minutes. The seat heating is activated and operated at the heating stage last selected at terminal 15 ON. The heating stage currently activated is indicated by the number of illuminated LEDs.

■ Monitoring of Temperature Sensor

The temperature sensor is permanently monitored. The seat heating and LEDs are switched off immediately if a short circuit or line break (open circuit) is detected. The system can be switched on only by means of the seat heating switch. The seat heating is deactivated when a short-circuit or an open circuit is detected in the temperature sensor. The LED lights briefly before the electronic module switches off. The seat heating can then be reactivated. The temperature sensor is checked again.

■ Seat Heating Output Management

If there is a drop in the vehicle's system voltage, the heating output is correspondingly adapted in 4 stages as follows:

- "No reduction", normal unrestricted operation.
- "25 % reduction", when heating stage 3 is set the system uses heating stage 2. However, the LED indicating stage 3 remains on. The system switches back to heating stage 3 when the heating output management signals "no reduction".
- "50 % reduction", seat cushion and backrest with side sections are heated at half capacity. The system switches back to 100 % heating output when the heating output management signals "no reduction".
- "Heating deactivated", the LED for the selected heating stage remains switched on. The seat heating is reactivated when the heating output management signals "no reduction".

Overvoltage/undervoltage Detection

■ Behavior in the Event of Undervoltage

The seat heating is switched off when the supply voltage for the SZM drops below a value between 11.0 V and 11.8 V for more than 5 seconds. The current seat heating setting is retained. The seat heating can be switched on again only when the voltage value is higher than 11.8 V to 12.6 V for longer than 4 seconds. The seat heating switch can be used to select the heating stage and switch off the system.

The LED remains on. The time limit of 5 seconds restarts when the seat heating is deactivated as the result of undervoltage being detected and then reactivated.

■ Behavior in the Case of Overvoltage

The seat heating is deactivated immediately when the supply voltage for the center console switch cluster (SZM) exceeds a value between 15.9 V and 16.7 V for longer than 0.1 seconds. The seat heating LED is switched off.

The seat heating and the LED indicator are not switched on again automatically when the normal voltage range from 11.8 V to 16.6 V is re-established. The LED may light briefly before the electronics is switched off when the seat heating is deactivated as the result of an overvoltage and then switched on again.

■ Short-circuit Detection

Actuation of the seat heating system is short-circuit-proof with respect to terminal 30 (battery positive terminal). The heating mats and LEDs are deactivated in response to a short-circuit. They can be switched on again only by means of the seat heating switch. The seat heating is also switched off as the result of increased power intake due to a defective heating mat.

■ No-load Detection

The LED cannot be activated when a heating mat is not connected or there is a break in the wiring (open-circuit).

The LED lights briefly when the seat heating is deactivated and briefly reactivated in the event of a short-circuit, the heating mat not connected or a break in the wiring. Consequently, the electronic circuitry switches off the seat heating system.

■ Plausibility Check of Temperature Profile

A plausibility check is performed only at a seat temperature of 30°C or less. This prevents the temperature in the backrest increasing to impermissibly high levels.

After the seat heating has been activated, the electronic circuitry expects a temperature increase at the temperature sensor. The seat heating is switched off immediately when the seat temperature is lower than 30°C and no increase in the temperature value is measured within 255 seconds.

The LED is also switched off.

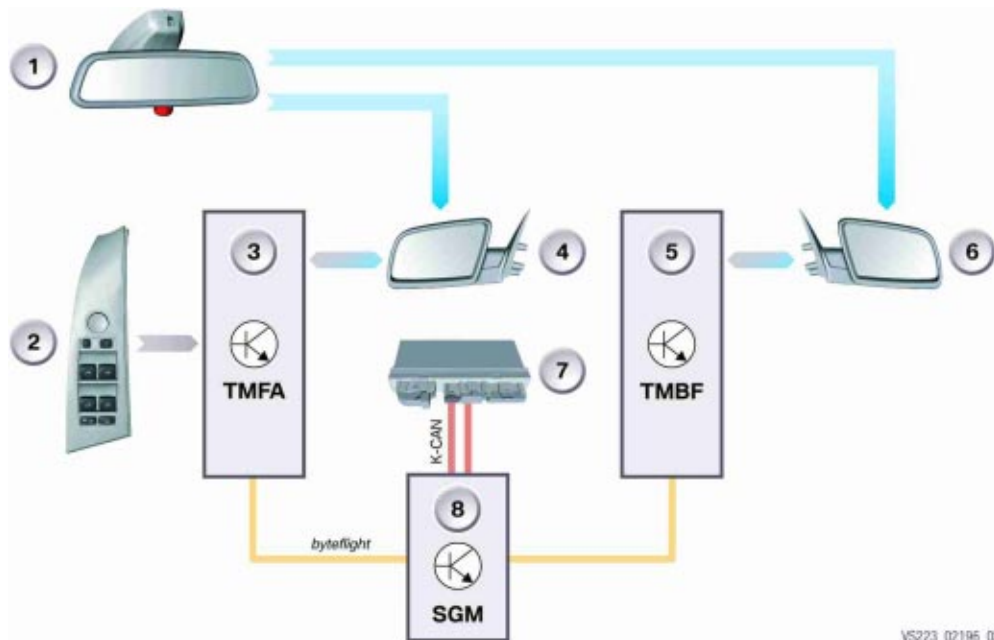
Outside Mirrors

Activation of the wing mirrors is performed by the door modules by means of the local electronics in the front doors. All the mirror functions, except for electrochromatic wing mirror and mirror heating, are active with terminal R on through to consumer shutdown.

The mirror functions are controlled exclusively in the door modules, which communicate with each other via the bytflight. All the mirror adjustment functions are served by the adjusting switches in the switch block in the driver's door.

The following options are available:

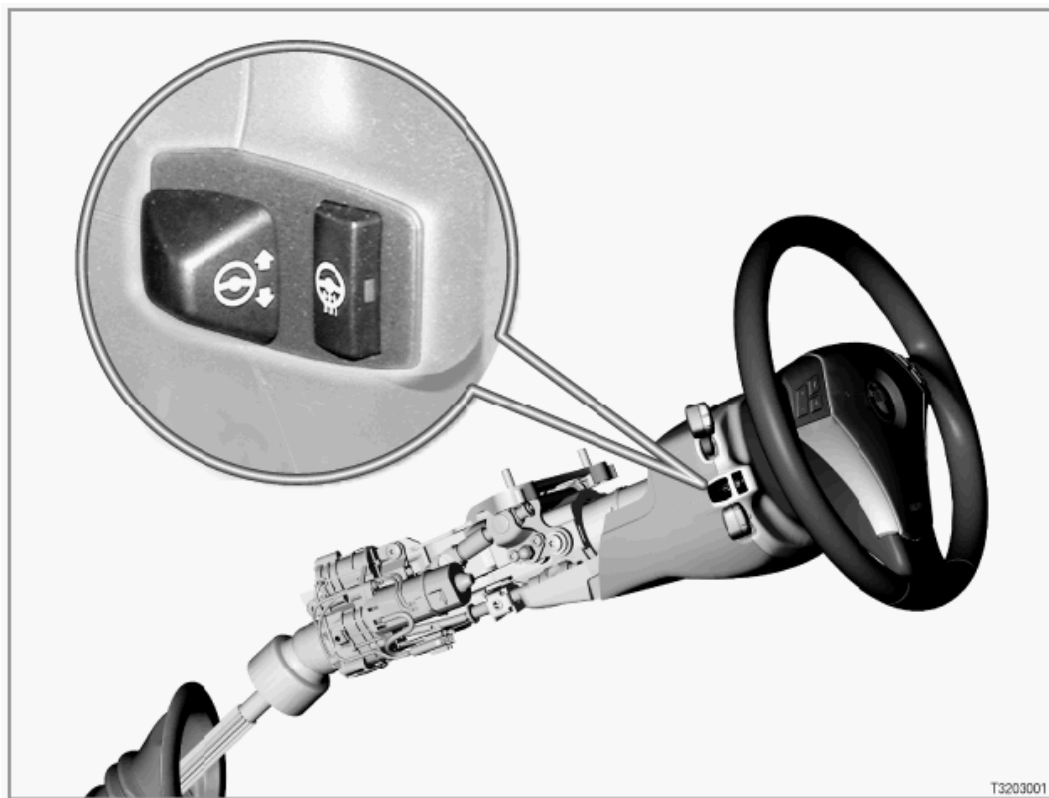
- Electrochromatic interior rearview and wing mirrors
- Electrochromatic interior rearview mirror
- Light package including front-area lights in wing mirrors
- Wing-mirror memory in conjunction with seat memory



Index	Explanation	Index	Explanation
1	Rear view mirror (Electrochromatic)	5	TMBF
2	Driver's switch block	6	Side view mirror, right (Electrochromatic)
3	TMFA	7	KBM
4	Side view mirror, left (Electrochromatic)	8	SGM

Steering Column Adjustment

The fully electric steering-column adjustment allows the driver to set the steering wheel to the best possible position. This is done with a switch on the left-hand side of the steering column. The tilt and fore-and-aft position of the steering column are adjusted by means of an electric motor.



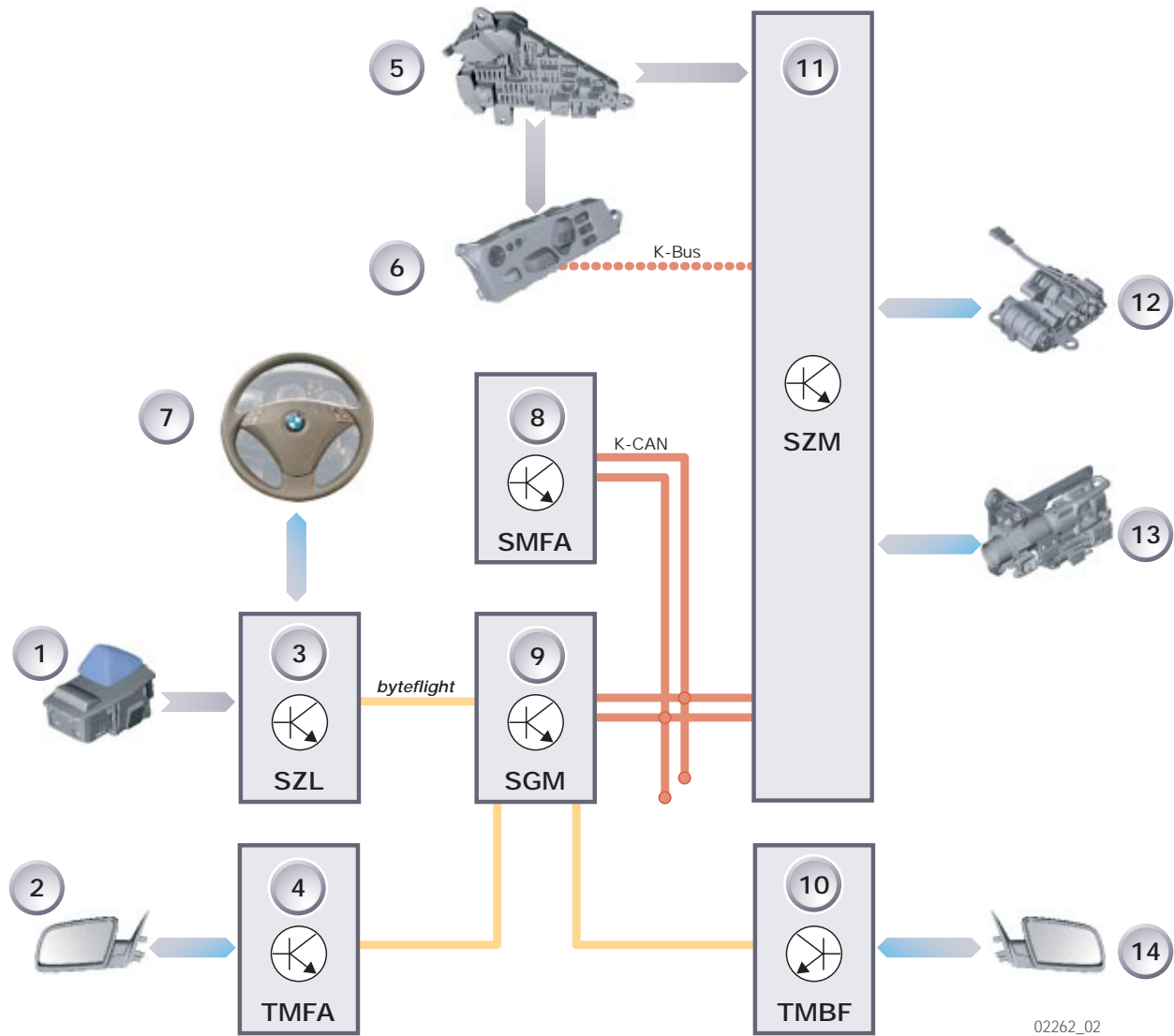
Vehicles with electric steering column adjustment have a steering-column memory in conjunction with seat memory and mirror memory.

The steering-column adjustment is actuated by the SZM. One motor drives the tilt and fore-and-aft adjustment. A second motor changes the direction of adjustment via the adjustment gears.

Possible functions of steering column adjustment are:

- Height adjustment
- Reach adjustment
- Entry/exit aid
- Steering-column memory
- Motor protection

Steering Column Adjustment (Overview)



Index	Explanation	Index	Explanation
1	Steering column adjustment button	8	Seat Module, Driver's Side (SMFA)
2	Exterior mirror, driver	9	Safety and gateway Module (SGM)
3	Steering column switch cluster (SZL)	10	Passenger Door Module (TMBF)
4	Driver's door module (TMFA)	11	Center Console Switch Center (SZM)
5	Power distribution, rear	12	Motor for steering column adjustment
6	Seat switches	13	Motor for steering column adjustment
7	Multi-function Steering wheel	14	Exterior mirror, passenger side

Components

The steering-column adjustment consists of the following components:

Switch for Steering-column Adjustment

This switch enables the driver to adjust the tilt and fore-and-aft setting of the steering column. The switch for steering-column adjustment is on the left-hand side of the steering column.

Steering-column Adjustment Drive Unit

Two motors are built into the drive unit. 1 motor drives the tilt and fore-and-aft adjustment of the steering column. The second motor changes the direction of adjustment via the adjustment gears.

The adjustment movement and position recognition for both tilt and fore-and-aft adjustment are recorded in the drive unit for the steering-column memory. There are 2 Hall sensors and 2 magnetic rings (16-pin) integrated in the drive unit.

Steering Column Switch Cluster

The switch for steering-column adjustment sends its signal to the SZL. The SZL forwards this signal to the SZM.

Signal path:

Switch for steering-column adjustment > SZL > byteflight > SGM > K-CAN > SZM.

SZM

The center console switch cluster (SZM) actuates the steering-column adjustment. The SZM also stores the positions for the steering-column memory.

Door Contact in the Driver's Door

The center console switch cluster requires the signal from the door contact in conjunction with the terminal status for the easy-entry system.

Signal path:

Driver's door contact switch > TMFA > byteflight > SGM > K-CAN > SZM

Principle of Operation

The fully electric steering-column adjustment comprises the following functions:

- Manual steering-column adjustment
- Steering-column memory
- Overheating protection for steering-column adjustment motors

Manual Steering-column Adjustment

The driver is able to adjust the steering column with a switch. When the switch is operated, the signal is transmitted cyclically from terminal 30 (cycle time: 100 milliseconds). The steering-column adjustment is actuated for as long as the signal is being received.

Once the switch is no longer actuated, the message "Stop" is transmitted 3 times.

The steering-column adjustment is stopped when this signal is received, or if the cyclic message is not received twice.

To enable a failure of the steering column switch cluster to be detected, a further a cyclic message is transmitted when the data bus is active (cycle time: 1 second).

When changing the direction of adjustment, the center console switch cluster first actuates the motor for setting the adjustment gears.

The actuation of this motor is time-dependent. The adjustment motor is not actuated until the direction of adjustment is correctly set. The total adjustment movement is no more than 36 millimeters for tilt adjustment and 40 millimeters for fore-and-aft adjustment.

Steering-column Memory

The position of the steering column in each direction of adjustment is recorded by a Hall sensor. This position is stored in the center console switch cluster (SZM). This allows the Key Memory to call up the position of the steering column for up to 4 vehicle keys.

The tilt adjustment moves to the uppermost position to make it easier to get in and out of the vehicle.

For the easy-access facility, the steering-column adjustment is automatically actuated under the following conditions:

- Terminal R OFF
- Terminal R ON and driver's door opened (via door contact)
- Terminal 15 OFF with driver's door open (via door contact)

The steering-column memory is activated under the following conditions:

- One of the two memory buttons for the seat-mirror memory and the steering-column memory on the seat is pressed (from terminal R OFF).
- Another remote control is used (personalization). Condition: The selection "Last seat position after unlocking" is activated in the "Settings" menu in the Central Information Display (CID) (from 09/2003).

In both cases, the steering-column memory will not move the steering column to the stored position until terminal 15 is switched ON.

Overheating Protection for Steering-column Adjustment Motors

To protect the motors against overheating, a temperature model is stored in the center console switch cluster.

The temperature model makes allowance for the warming up and cooling down of the motors.

It is possible to move the steering column in either direction through the range of movement at least 6 times before overheating protection is activated.



Classroom Exercise - Review Questions

1. Describe the signal path from the Driver's door switchblock to actuate the E60 roller sunblind:

2. What control module stores the steering column memory settings?

3. On the E64, how is the customer informed that the seat backrest is not locked? Why is this information important to the driver?

4. Describe the signal path for seat heating: (between switch and heating mats).
